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COMMENTS ON THE DEFINITION OF THE GENUS *DIPLOPAPPUS* CASS.
(ASTERACEAE: ASTEREAE)

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ABSTRACT

Diplopappus Cass. (1817), as first defined, comprised two species of *Erigeron* L., two of *Chrysopsis* (Nutt.) Ell. (1824), and one that is likely to be either a species of *Heterotheca* Cass. (1817) or another of *Chrysopsis*. The taxa of *Erigeron* were soon removed from *Diplopappus* by Cassini, but the status of the genus relative to its three other, original, constituent taxa remains unsettled. In any case, *Diplopappus* is based on North American plants and should eventually be treated as a synonym of either *Chrysopsis* or perhaps *Heterotheca*. It is not a synonym of *Aster*, as has sometimes been claimed.

KEY WORDS: *Diplopappus*, *Chrysopsis*, *Aster*, Astereae, Asteraceae

The genus *Diplopappus* Cass. has received a varied and uneven treatment, absorbing many species from a range of genera now recognized to be of widely separated evolutionary affinities. It is now generally relegated to synonymy, although its position and status are not settled. Hooker (*Fl. Bor.-Amer.* 2:20-23. 1834) included a wide range of North American taxa within *Diplopappus*, and Hooker & Arnott (1836) soon expanded the genus further to encompass a large group of South American species now placed primarily in *Haplopappus* DC. In DeCandolle's treatment (*Prodr.* 5:275-278. 1836), *Diplopappus* included species now treated as *Felicia* Cass., *Ionactis* E. Greene, and two groups of *Aster* L. (one from South Africa, one from Asia). Harvey (1865) accepted DeCandolle's concept, in part, but sharply restricted *Diplopappus* to two groups of African species now regarded as *Felicia* and *Aster*. Torrey & Gray (*Fl. N. Amer.* 2:180-184. 1841) included species of *Ionactis* and *Chaetopappa* DC. but expanded the concept of *Diplopappus* in a markedly different direction also to include species of *Doellingeria* Nees and the South

American *Diplostephium* Kunth. Gray (1884) later completely dismantled North American *Diplopappus* and distributed its accumulated taxa through a number of genera, including (as now recognized) *Aster*, *Chaetopappa*, *Ionactis*, *Erigeron* L., *Heterotheca* Cass., *Chrysopsis* (Nutt.) Ell., *Pityopsis* Nutt., *Corethrogynne* DC., and *Machaeranthera* Nees.

The early usage of *Diplopappus* beyond Cassini, however, moved far from its original conception. In a brief but apparently legitimate, initial publication of *Diplopappus* (1817), Cassini did not treat any specifically designated species, but two years later (*Dict. Sci. Nat.* 39:103. 1819) he formally included five species. Two of these were taxa now placed in the North American genus *Chrysopsis*, two now placed as North and Central American species of *Erigeron*, and the identity of the other (*Diplopappus villosus* Cass.) remains uncertain, although it may be *Heterotheca* (see below).

Diplopappus Cass., *Bull. Sci. Soc. Philom. Paris* 1817:137. 1817. SYNTYPES (*Dict. Sci. Nat.* 39:103. 1819):

Diplopappus lanatus Cass. (= *Chrysopsis gossypina* [Michx.] Ell.);
Diplopappus intermedius Cass. (= probably *Chrysopsis gossypina*);
Diplopappus dubius Cass. (= *Erigeron annuus* [L.] Pers.);
Diplopappus delphinifolius Cass. (= *Erigeron delphinifolius* Willd.);
Diplopappus villosus Cass. (? = *Heterotheca villosa* [Pursh] Shinners).

The two species of *Erigeron* were later excluded by Cassini himself in favor of positions in other genera, and they also were formally excluded in the treatment by DeCandolle, who also referred them to other genera. *Diplopappus* can reasonably be rejected as a synonym of *Erigeron* (Nesom 1989). Semple (1981) listed *Diplopappus* Cass. as a synonym of *Chrysopsis* in his revisional treatment of the latter; he indicated without explanation that *Diplopappus* is a "nom. illeg." He included *D. lanatus* Cass. as a synonym of *C. gossypina*, probably based on Cassini's own treatment of *C. gossypina* as a synonym of *D. lanatus*, but he did not provide an identity for *D. intermedius* Cass. According to Cassini (1819), however, the latter differs very little from *D. lanatus*, and *Index Kewensis* (probably on the basis of Cassini's comment) indicates that it perhaps is a synonym of *C. gossypina*.

With regard to *Diplopappus villosus*, Cassini (*Dict. Sci. Nat.* 13:309. 1819) noted that "Nous ignorons la patrie de cette plante, que nous avons etudiee dans l'herbier de M. de Jussieu, ou elle est etiquetee, par erreur sans doute, *Aster alpinus* B. Linn." Cassini described this plant as herbaceous, highly branched, with alternate, sessile, lanceolate-acute, entire leaves villous or velutinous ("velues") on both surfaces, with yellow flowers in heads in a corymbiform panicle, achenes obovate and flat, with an outer series of short, flat

squamellae and inner series of barbellate bristles. Its identity remains unclear, and I have been unable to locate in the Jussieu herbarium (on fiche) a specimen that might correspond to Cassini's description, but it may yet be found there. In any case, the specimen was collected by Michaux (*fide* Cassini) and almost certainly came from North America. Based on Cassini's description, its assignment to *Chrysopsis* or *Heterotheca* sect. *Phyllotheca* (Nutt.) V. Harms (see Semple 1987) seems reasonable.

Both Farr *et al.* (1979) and Heywood *et al.* (1977) positioned *Diplopappus* as a synonym of *Aster* L., these opinions probably reflecting the association of the name *Diplopappus* with South African asters. The problematic identity of these species with *Diplopappus*, however, has been noted or discussed in relatively recent literature (Merxmüller 1954; Grau 1973; Dyer 1975). Jeffrey (1990) also placed *Diplopappus* as a synonym of *Aster* L., but he noted that the three "syntype species" are from North America. *Aster* in any sense, however, could be regarded as incorporating *Diplopappus* only if the identity of *D. villosa* Cass. were established as an *Aster* and that taxon chosen as the lectotype of *Diplopappus*. *Diplopappus villosus* certainly is not any species of *Aster* sensu lato if Cassini's description of "fleurs jaunes" is accurate and applies to both ray and disc flowers. DeCandolle (1836), however, specifically noted that he separated the genus *Chrysopsis* from *Diplopappus* on the basis of yellow rays in the former, and, in fact, the only treatment of *Diplopappus* since Cassini's to include yellow-rayed taxa has been that of Hooker & Arnott. DeCandolle's treatment of *Diplopappus* included none of the five species first placed there by Cassini.

If *Diplopappus* were lectotypified with one of the two species that seem clearly to be *Chrysopsis*, Cassini's generic name would have priority over that of Ellis: (*Chrysopsis* [Nutt.] Ell. 1824, based on *Inula* sect. *Chrysopsis* Nutt. 1818). Hooker (*Fl. Bor.-Amer.* 2:22. 1834) treated *Chrysopsis* within *Diplopappus* Cass. and included *D. villosus* as one of the species, listing in its synonymy *Chrysopsis villosa* (Pursh) Nutt. (= *Heterotheca villosa* [Pursh] Shinners). Hooker did not provide a citation of authorship for *D. villosus*, although its listing from that reference in *Index Kewensis* implied that the authorship was intended to be *D. villosa* (Pursh) Hook., in contrast to *D. villosus* Cass. *Diplopappus villosus* Hook. & Arn. (*Companion Bot. Mag.* 2:48. 1836) is a taxon now treated as a South American species of *Hysterionica* Less. and is heterotypic with the North American homonyms.

If the identity of *Diplopappus villosus* Cass. were established as a synonym of *Heterotheca villosa* (Pursh) Shinners, as seems possible, *Diplopappus* could be treated simply as a synonym of *Heterotheca* Cass., which was established as the next genus following *Diplopappus* in Cassini's 1817 paper. As pointed out by Dr. Semple, however, in his comments on this paper, Michaux could not have collected *H. villosa* in eastern North America, and plants of that species hardly fit the description of "highly branched." Further, species of *Chrysopsis*

are variable in the amount of indument produced, often giving them a markedly different aspect, and it is possible that Cassini's *D. villosus* was based on yet another plant of *Chrysopsis*. The location of Cassini's type (the Michaux specimen in the Jussieu herbarium) and its identification as *Heterotheca* would provide the simplest solution. Otherwise, it may ultimately become necessary to lectotypify *Diplopappus* with *D. lanatus* and then to conserve *Chrysopsis*, a genus already once conserved (over an earlier generic name of Rafinesque: see ICBN 1972 and Semple 1981).

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I thank Billie Turner, John Semple, and Tom Watson for their comments and review of the manuscript.

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**ERIGERON JENKINSII (ASTERACEAE: ASTEREAE), A NEW SPECIES
FROM THE RIO MAYO AREA OF SONORA, MEXICO**

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ABSTRACT

A new species, *Erigeron jenkinsii*, is described from two collections from the Río Mayo area east of Alamos in Sonora, México. It is apparently most closely related to *E. delphinifolius* but is particularly characterized (and contrasted with the latter) by its thin, elliptic-ob lanceolate, and relatively small leaves with mostly entire margins, open capitulace nce, small heads with few flowers, and eglandular phyllaries.

KEY WORDS: *Erigeron*, Astereae, Asteraceae, Río Mayo, México

Exploration and intensive collecting in the Río Mayo region of southernmost Sonora has brought to light a new species of *Erigeron* L. The species is named for its first collector, Philip D. Jenkins, Assistant Curator of the Herbarium at the University of Arizona in Tucson.

***Erigeron jenkinsii* Nesom, sp. nov.** TYPE: MEXICO. Sonora: Río Mayo region, Vallecitos, near Santa Barbara, ca. 22 km by air ENE of Alamos; ca. 27°07' N, 108°43'30" W; 30 Oct 1991, *P. Jenkins* 91-119 (HOLOTYPE: ARIZ!; Isotype: TEX!).

Erigeronti delphinifolio Willd. similis sed foliis tenuioribus elliptici-ob lanceolatis plerumque integrisque, capitulis multo minoribus flosculis paucioribus, phyllariis eglandulosis, et acheniis nerviis lateralibus tenuibus differt.

Annual herbs from a slender taproot. Stems mostly single from the base, 15-60 cm tall, with 5-10 primary branches on the upper half, eglandular, the upper portions moderately to densely strigose or strigose-hirsute with sharply upturned hairs 0.1-0.5 mm long, these less dense and spreading below. Leaves

eglandular, minutely and sparsely strigose to short-pilose, obovate or elliptic-obovate to narrowly oblanceolate, not clasping, with a distinct petiolar region 1/10-1/8 as long as the leaf, with margins entire or sometimes with 1-2 pairs of coarse teeth, the largest near midstem, 25-40 mm long, 5-13 mm wide, reduced in size upwards but continuing relatively large until immediately beneath the heads where bracteate. Heads 4-6 mm wide, 1-ca. 20 in a loose, paniculate capitulecence barely recognizable as corymboid; phyllaries linear-lanceolate, 2-3 mm long, sparsely strigose to strigose-hirsute, eglandular or with a few minute glands. Ray flowers 24-40 in 1-2 series, the corollas white, (5-)7-9 mm long, the ligules 1 mm wide. Disc corollas 1.8-2.2 mm long. Achenes 0.8-1.0 mm long, sparsely strigose, the 2 lateral ribs very thin; pappus of 6-10 basally caducous bristles nearly as long as the disc corollas, without an apparently outer series.

Additional collection examined: MEXICO. Sonora: E slopes of the Sierra de Alamos, 7 km SW of Alamos, Arroyo el Huirotal (= Arroyo el Guaje), Rancho Uvalama, 26°56'15" N, 108°57'W; edge of streambed in tropical deciduous forest, 650 m, 13 Oct 1992, T.R. & R.K. Van Devender 92-1910 (ARIZ).

The two collections of *Erigeron jenkinsii* are separated by about 40 kilometers. Three or four plants with slender taproots, clearly of annual duration, are represented in the Jenkins collection. The Van Devender sheet bears a single, considerably more robust individual, described by its collectors as "perennial;" the root is missing, however, and there is no doubt that all of these plants are the same species. The marked variation in size among the different individuals is characteristic of annuals.

In its linear phyllaries, narrow white ray corollas sharply reflexing at the ligule-tube junction, and its few, basally caducous pappus bristles, *Erigeron jenkinsii* is clearly a member of *Erigeron* sect. *Polyactis* (Less.) Nesom (Nesom 1989). In this section of 20 species, there are only three previously described annuals, two of which occur in northwestern México: *E. delphinifolius* Willd., which appears to be the closest relative of the new species, and *E. inoptatus* A. Gray, which has densely glandular vegetative parts and is related to a different group of species.

The new species differs from *Erigeron delphinifolius* Willd. in a number of features: (1) thinner, smaller, and mostly entire leaves (25-40 mm long and 5-13 mm wide vs. 15-90 mm long, 3-50 mm wide and pinnately dissected), (2) open capitulecence (vs. distinctly corymboid though sometimes few-headed), (3) smaller heads with fewer flowers (heads 4-6 mm wide with 24-40 ray flowers vs. 7-14 mm wide with 110-240 or more ray flowers), (4) eglandular phyllaries (vs. minutely but distinctly granular-glandular), and (5) achenes with thin ribs (vs. thick ribs).

Erigeron delphinifolius is a common species in central Durango and from there is scattered southward to the Trans-volcanic Range, where it is a locally abundant colonizer of open areas from Jalisco eastward to Puebla and Tlax-

cala. At the northwestern extremity of its range, it is known by a single, recent collection from west-central Chihuahua (the only collection from that state, not shown on the 1989 map) of plants relatively typical in morphology for the species. *Erigeron jenkinsii* also occurs at the northwest end of the range of *E. delphinifolius*, but the two are completely separated in distribution.

As noted earlier (Nesom 1989), *Erigeron delphinifolius* is the only species of sect. *Polyactis* that ranges outside of the western Sierra Madre. Further, the center of morphological variability for this species is in Durango, where plants commonly produce tripinnately dissected leaves. This is "near the center of species diversity for the section [primarily Chihuahua, Durango, and Sonora] and it is almost certain that the wide distribution of *E. delphinifolius* across the trans-volcanic mountains was attained after its evolutionary origin in the western sierra" (p. 438). In this perspective, *E. jenkinsii* may have arisen from the same ancestral stock that produced *E. delphinifolius*, a hypothesis weighting annual duration as a synapomorphic feature of the two species.

Occasional plants of *Erigeron neomexicanus* A. Gray produce a preponderance of entire leaves, but that species is a large-headed perennial usually with strongly dissected leaves, and it is almost certainly the sister taxon of *E. oreophilus* Greenman, another species with dissected leaves. *Erigeron annuactis* Nesom, the only other species in the section with entire leaves, occurs in Michoacán and has been hypothesized to be closely related to *E. delphinifolius* or derived from it (Nesom 1989). Relative to *E. jenkinsii*, however, *E. annuactis* is larger in stature and produces larger, epiiolate leaves, glandular phyllaries, and larger heads with more numerous flowers, and the two species surely have had independent origins.

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Nesom, G.L. 1989. Taxonomy of *Erigeron* sect. *Polyactis* (Compositae: Astereae). *Phytologia* 66:415-455.

**A NEW SPECIES OF *PERYMENTIUM* (ASTERACEAE, HELIANTHEAE) FROM
JALISCO, MEXICO**

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ABSTRACT

A new species of *Perymenium*, *P. huentitanum* B.L. Turner, is described and illustrated from near Guadalajara, Jalisco, México. It is believed to be closely related to a cluster of recently described suffruticose herbs of northeastern México, namely *P. hintoniorum* B.L. Turner and *P. tamaulipense* B.L. Turner.

KEY WORDS: Asteraceae, Heliantheae, *Perymenium*, México, Jalisco

Routine identification of Mexican Asteraceae has revealed the following novelty.

***Perymenium huentitanum* B.L. Turner, sp. nov.**, Figure 1. TYPE: MEXICO. Jalisco: Mpio. Guadalajara, Barranca de Huentitán, ca. 492 m, 31 Aug 1992, S. Guerrero A. & G. Perea G. 411 (HOLOTYPE: TEX; Isotype: IGE).

Perymenio tamaulipensi B.L. Turner similis sed capitulis anguste campanulatis (vs. hemisphaericis), involuci bracteis interioribus flavi-scariosis apicibus acutis (vs. viridibus apicibus rotundatis), et flosculis radii 5-6 (vs. 10-11) differt.

Mostly unbranched stiffly erect suffruticose herbs 1 m high. Stems terete, moderately strigose with upturned hairs. Leaves mostly 8-14 cm long, 3-5 cm wide; petioles 0.5-1.0 cm long; blades ovate, thin, drying black, 3-nervate from the base or nearly so, moderately hispid-pilose beneath, the margins serrate with 10-15 serrations to a side, the apices narrowly acute. Heads 7-9, terminal

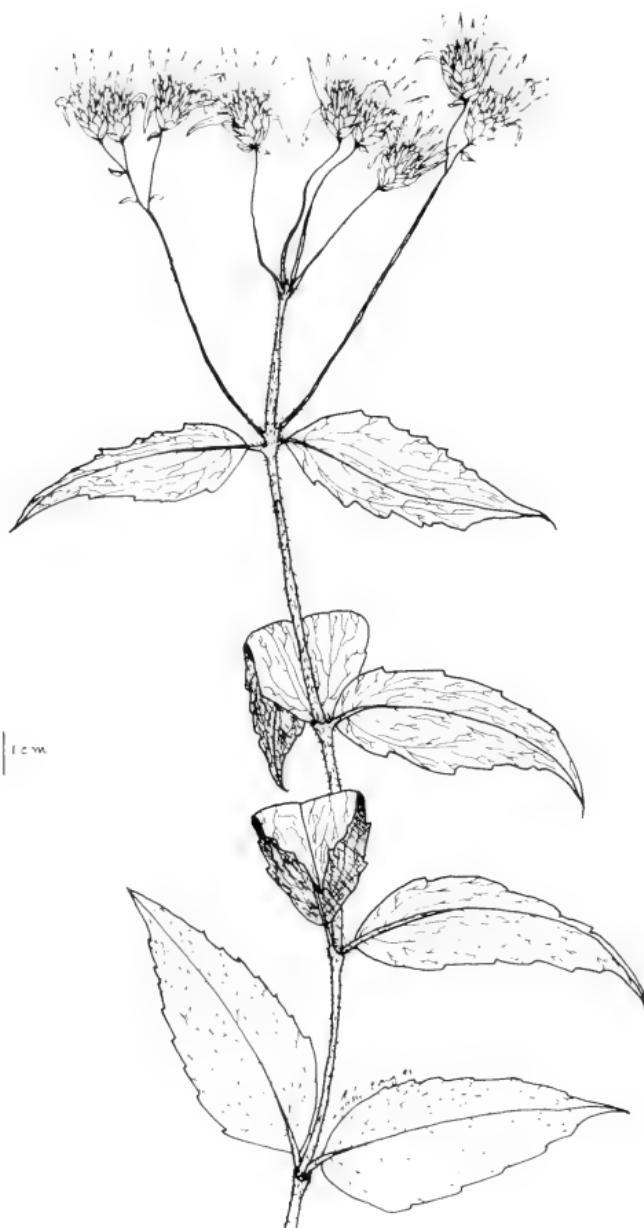


Figure 1. *Perymenium huentitanum* B.L. Turner, from holotype.

in subfasciculate terminal cymes, the ultimate peduncles mostly 1-5 cm long. Involucres campanulate, 7-8 mm high, 4-6 mm wide (pressed), the bracts 3-4 seriate, graduate, the inner bracts yellow-scarious with acute ciliate margins, these grading into the yellow linear-lanceolate persistent pales. Receptacles convex, ca. 2 mm across. Ray florets 5 or 6, pistillate, fertile, the corollas with yellow ligules 10-12 mm long, 1.5-2.5 mm wide, the apices bifid. Disk florets 12-20 per head, the corollas glabrous or nearly so, ca. 6 mm long, the tube ca. 1.5 mm long, the lobes ca. 1.5 mm long. Achenes (immature) wingless, 3.0-3.5 mm long, hispidulous; with a well defined boss off of which arise a pappus of 20-30 deciduous bristles 1-3 mm long, the shoulders of the body with 2 persistent hispid awns 0.5-1.0 mm long.

This species will not key in McVaugh's (1984) account of *Perymenium* for his *Flora Novo-Galiciano*, nor is it accounted for in Fay's (1978) revision of the genus, where it will key to or near *P. hintonii* McVaugh of Michoacán and México, the latter having spheroid heads with involucral bracts rounded apically and more numerous florets. *Perymenium huentitanum* appears closest to a series of recently described taxa from northeastern México, namely *P. tamaulipense* B.L. Turner and *P. hintoniorum* B.L. Turner, having the habit, rounded stems, capitulescence, and involucral characters of these. It differs from both in having narrowly campanulate involucres, the inner bracts yellow-scarious with acute apices.

ACKNOWLEDGMENTS

I am grateful to Guy Nesom for the Latin diagnosis, and to him and Mahinda Martínez for reviewing the manuscript.

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ON THE BIOECOLOGY OF THE FUNGUS *PLASMOPARA VITICOLA* BERLESE & DE TONI CAUSING VINE MILDEW

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ABSTRACT

New data on the bioecological characteristics of *Plasmopara viticola* Berl. & de Toni are presented. The results of microscopic analysis of mycelium wintering of mildew causing *Plasmopara viticola* on branches and fruit bearing buds are discussed.

KEY WORDS: Vine mildew, *Plasmopara viticola* Berl. & de Toni, mycelium wintering, Müller Curve

Among the main diseases of vine, mildew is notable by its harmfulness. The effective control of this disease depends primarily on study of the bioecology of the disease pathogen, its wintering mechanism, and resumption of infections. Though the vine mildew has been studied for a long time, not all the bioecologic aspects of the fungus are clear at present and some key issues of the fungus causing the mildew, as well as the methods of defense against it still require significant study.

Results are presented of an investigation on the bioecology of the fungus causing vine mildew, and methods of defense against the disease. This work has been carried out during the past two decades in geographically separate areas of the Republic of Georgia (Chrelashvili 1978, 1984, 1985, 1988; Chrelashvili & Salukvadze 1985). The four geographically separate zones selected were: Kvarely, Sagaredjo (east Georgia), Maiakovsky and Gudauta (west Georgia). The results are likely applicable in other countries where viticulture is undertaken.

Past workers have agreed that one of the key issues of the bioecology of the fungus is the survival of the fungus during the period of overwintering and renewal of the fungal infection upon revegetation. It has been accepted that

the mechanism of overwintering is through oospores found in the so called necrotic spots of leaves that fall into the soil, and that re-infection is accomplished by splashing of fungal spores from the soil to the leaves of the vines. The disease becomes apparent immediately after the vines produce leaves, when the day and night temperatures become 12-15° C, and rainfall occurs. Viala (1887, 1893), Speshnev (1906), Andreev (1925), Gregory (1912, 1914), Boubals (1977), Prince (1962), Verderevski & Voitovich (1970), Natsarashvili (1972), and others have all considered the problem of overwintering and renewal of infection of vine mildew.

Other authors (Yachevski 1909; Istvanp & Palinkas 1913) have expressed the opinion that presence of the fungus in wintering buds of the vine is the mechanism for overwintering and source of infection in the following growing season. Yachevski (1909) hypothesized that the infection spreads from the buds by diffusion. With the exception of Naidenova (1974), this mechanism of overwintering and re-infection has not been examined.

The necessity of a more critical determination of the exact mechanism of overwintering and re-infection of vine mildew was caused by the following facts, each of which will be discussed below:

1. Observations have indicated that the actual appearance of vine mildew is delayed by a month or more after the date predicted using the scenario implied in the accepted method of overwintering and infection.
2. The method by which the fungus spreads once infection has occurred is not known.
3. Infections were noted to spread much faster than predicted by the widely accepted method of infection.
4. Infections occurred even when the possibility of a soil borne infection source was eliminated.

1. The theoretical date of the first appearance of vine mildew is usually predicted by a curve of incubation periods (*i.e.*, the *Müller Curve* [Müller & Rabanus 1923]). Based on the determination of this date, antifungal treatments are begun. Observations during the past two decades have shown that the actual first appearance of the mildew is delayed one month and sometimes more beyond the date predicted by the *Müller Curve*.

The results of these observations from one climatic zone (Kvarely region in east Georgia) are shown in Table 1. The first column in the table shows theoretical dates of appearance, the second column shows actual dates of appearance, and the third column indicates the year in which the observations were made.

Table 1. Comparison of theoretical and actual first dates of appearance of vine mildew.

theoretical, according to the <i>Müller Curve</i>	actual	Year of observation
month/day		
05.04	06.02	1971
04.18	05.20	1972
05.05	06.05	1973
05.11	06.06	1974
04.25	05.26	1975
05.07	05.30	1976
04.28	05.31	1977
05.10	06.05	1978
05.29	07.02	1979
05.14	06.18	1980
04.27	05.17	1981
05.15	07.02	1982
05.25	07.05	1983
05.16	07.02	1984
05.15	06.18	1985
05.10	06.25	1986

The observations made regularly from 1971-1986, have shown that the appearance of vine mildew on the plants coincides not with the predicted appearance based on climatic variables, but with the opening of floral buds. In each case, mildew was first observed as, or shortly after flower buds opened. Widely accepted theory predicts that infection will occur earlier, when leaf buds break. However, as we have observed, the appearance of the disease is correlated with a specific phenological phase of vine, namely with the "preflowering" period. At this stage the plant mobilizes large amounts of its resources to support the flowering and fruiting, and is richest from the viewpoint of nutrient medium. The combination of the availability of these resources, along with favorable climatic conditions, formates most favorable conditions for rapid development of the fungus.

2. Following the widely accepted mechanism of infection and incubation period for the fungus, the process of continuous formation of the mildew on vine leaves is not satisfactorily explained. Raikov & Ionov (1958), Dudin & Dementieva (1958), and others have suggested that night dew is responsible for the continuous formation of vine mildew.

However, observations reported here, taken over several years, show that the process of continuous formation of vine mildew takes place even without night dew or rain. Table 2 contains the meteorological data from July 1976 at the experimental site, along with data on vine mildew infection. During the two week observation period, newly infected leaves were observed each day, even though neither rain nor night dew occurred during this period. These observations are particularly interesting in light of the fact that the fungus is known to infect by entering through the stoma of leaves when water is present.

3. An inconsistency was noted between leaf age and incubation periods for appearance of vine mildew as predicted by use of the *Müller Curve*. In particular, when incubation period according to the *Müller Curve* was 5-6 days, fungal damage was also observed on 2-3 day old leaves. According to previously accepted patterns, infection should take place through the edges of the leaves when water is present and the infestation should become observable after an incubation of 5-6 days. The fact that infections appear in 2-3 day old leaves indicates that if the incubation actually takes 5-6 days, then infection could not have occurred as described. Consequently, an internal infection source is indicated by these data. Figure 1 shows a curve depicting percentage of damaged leaves by age of leaves. The abscissa corresponds to the age of leaves (in days), and the ordinate corresponds to the percentage of damaged leaves. Maximum damage appears in 8-9 day old leaves, with minimum damage in 2-3 day old leaves.

4. According to the literature, grafts and seedlings are most susceptible to mildew, and infection originates from soil as a result of raindrops splashing contaminated soil onto the leaves or by wind carrying oospores from contaminated soil onto the leaves. Experiments were conducted to test the hypothesis

Table 2. Climatic data and observations of leaves during July 1976. The total number of leaves observed was 890. No precipitation nor dew was recorded during the period.

date	air temperature		relative humidity		ground temperature		dew point		number of infected leaves
	° C	° C	%	%	° C	° C	° C	° C	
	3am	6am	3am	6am	3am	6am	3am	6am	
07.01	19.7	19.2	70	72	17	19	14	14	5
07.02	17.8	18.1	82	79	16	19	16	19	6
07.03	17.5	17.8	64	67	15	17	11	12	10
07.04	15.8	16.4	53	52	13	15	6	6	12
07.05	17.8	14.5	81	75	11	14	10	10	6
07.06	15.2	16.2	76	75	13	16	11	12	7
07.07	16.4	18.2	78	73	15	18	13	13	4
07.08	19.0	19.2	64	63	17	20	12	12	11
07.09	18.5	18.3	68	76	18	19	12	14	12
07.10	19.5	19.7	77	79	18	21	15	16	4
07.11	21.2	21.2	77	71	19	20	16	16	6
07.12	19.8	20.1	76	78	19	21	15	16	2
07.13	18.0	18.4	81	78	14	17	15	15	1
07.14	19.9	17.3	64	71	18	18	13	12	1

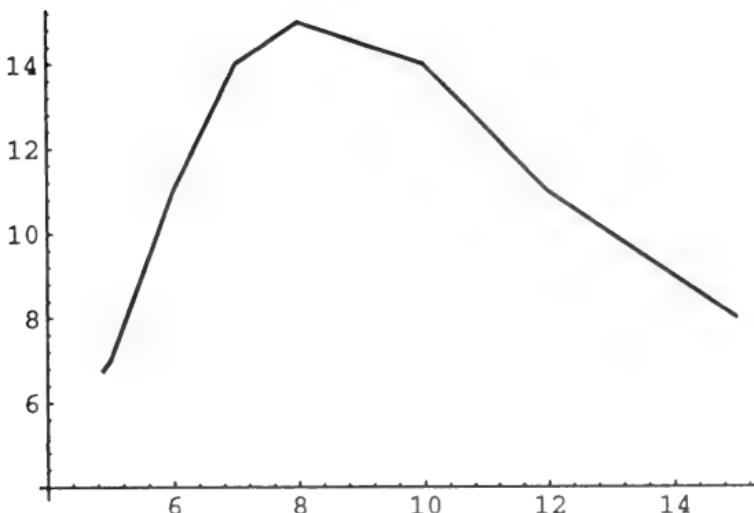


Fig. 1. The amount of damaged leaves in percentage (the axis of the ordinate) vs. the age of the leaves in days

of soil originated infection.

In order to test the accepted methods for infection, 80 square meters of prepared soil was covered with polyethylene. Holes were made in the polyethylene just large enough to plant the seedlings. A control plot was made with plants placed in uncovered soil.

Experimental plants grew more rapidly in general, and expressed mildew infections approximately 20 days earlier than control plants. The more rapid growth was likely due to elevated temperature and moisture levels under the polyethylene. However, since the possibility of infection by splashing of contaminated soil had been excluded, the more rapid appearance of the fungal infections on experimental plants can only be explained if the infection were already present in the seedlings, in which case, the more rapid appearance of mildew on experimental plants could also be explained by the elevated temperature and moisture levels under the polyethylene.

Another experiment in which the experimental treatment involved seedlings placed in closed pots in a greenhouse showed similar results (i.e., mildew infections became apparent approximately 20 days earlier in experimental plants than in control plants). In this case, the possibility of wind borne infection, as well as water borne infection had been excluded. These data suggest that the source of these outbreaks of mildew is from within the tissues of the plant, and that the appearance of the fungus is not predicated on an infection source,

Table 3. The results of light microscopic analysis.

Sample	Number of sections	Number of sections where mycelium was observed
1	10	1
2	10	0
3	10	2
4	10	1
5	10	3

but merely the presence of conditions under which the fungus can grow rapidly and become apparent.

The possibility of an infection source from within the plant tissue is suggested by the well known fact that vine mildew was introduced to Europe by a sample phylloxeraprofraft brought from America in 1887. It is also known that other perenosporals (such as *Plasmopara*) winter in the plants as a latent infection. It would appear based on the data presented here, that the vine mildew is no exception.

The data presented above lead to the conclusion that previously accepted hypotheses on the source of infection of vine mildew are inaccurate, and the inappropriateness of use of the *Müller Curve* to predict when vine mildew becomes apparent. Further, the data suggest that the source of early season vine mildew outbreaks is a latent infection within the plants. If this is the case, then the fungal infection would be expected to be present in samples of the plant tissue. Microscopic analyses were conducted to determine whether the fungus was present in apparently uninfected plant tissue.

Sections were made on a microtome from shoots collected in the spring, that had expressed infection during the previous growing season. Light microscope examination showed that fungal mycelium was present in many sections (Table 3). The fact that mycelium was not observed in all sections suggests that the fungus may not be present in all tissues. However, even though not found throughout the plant, the presence of fungal mycelium in any portion of the plant would allow much more rapid expression of the fungus than if the infection were required to be introduced from outside the plant.

Electron microscope analyses carried out using a YEM-10013 transmission electron microscope, provided further information on the existence of fungal infections in dormant plant tissue. Experimental material was treated to prevent other diseases than vine mildew. Control material was free of all known pathogens. Longitudinal sections were made and observed under the microscope. Cells of control tissues had well defined edges, quite thick osmophilic

globulations, and roundish mitochondria. In experimental tissue, cell boundaries were ill defined and the fungal mycelium was clearly seen.

CONCLUSION

It is clear that previously accepted hypotheses considering the infection and spread of vine mildew are inaccurate, and that treatment protocols based on those hypotheses are flawed. Specifically, early season treatments to control the spread of the disease, or prophylactic treatments to prevent infection are unnecessary. Based on the findings of this study, new treatment protocols have been developed for use in Georgia. These treatments have provided control as well as previous treatments, but since they are made less often, a substantial savings in treatment expenditures has been realized.

The currently used treatment schedule is as follows:

1. A sanitary treatment or "autumn measure", carried out as soon as the vintage is completed. This is a systemic treatment aimed at reducing the amount of fungal material available for overwintering while the fungus is still localized in the plant.
2. A preblooming treatment directed at reducing spread of any fungus in the plant and timed to coincide with the first outbreak of the fungus without treatment.
3. Immediately after flowering, directed at reducing spread of any fungus in the plant.

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**VERBESINA ARAMBERRANA (ASTERACEAE, HELIANTHEAE) A NEW
GYPSEOUS SPECIES FROM NUEVO LEON, MEXICO**

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ABSTRACT

A new species, *Verbesina aramberrana* B.L. Turner, is described from gypseous soils of southernmost Nuevo León, México. It is closely related to the recently described *V. hintoniorum* B.L. Turner and *V. zaragozana* B.L. Turner, both gypseous species from southern Nuevo León. All of these possess very localized distributions and each has very distinctive vestiture. So far as known they do not grow together, nor do they intergrade.

KEY WORDS: Asteraceae, Heliantheae, *Verbesina*, México

Routine identification of Mexican Asteraceae has revealed the following novelty.

Verbesina aramberrana B.L. Turner, *sp. nov.* TYPE: MEXICO. Nuevo León: Mpio. Aramberri, San Francisco, gypsum hillside, 1750 m, 26 Aug 1992, *Hinton et al.* 22359 (TEX!).

Verbesinae hintoniorum B.L. Turner similis sed foliis sparsim hispidis trichomatibus brevibus basi lata exorientibus (vs. conspicue aequaliterque pubescentibus trichomatibus relative longis molli-appressisque cellulis basalibus inconspicuusque exorientibus) et bracteis involucri obtusis vel obtusatis (vs. apiculatis vel mucronatis) differt.

Suffruticose perennial herbs or shrublets 50-60 cm high. Stems strigose with upturned white hairs. Midstem leaves alternate, linear to linear-lanceolate, mostly 3-7 cm long, 0.2-1.0 cm wide, sessile or nearly so, rough hispid-pilose,

especially along the margins, the hairs sclerose, white, with broad multicellular bases. Heads radiate, hemispheric, 1-20 in terminal stiffly erect cymes, the ultimate peduncles mostly 3-11 cm long, rarely single on peduncles up to 20 cm long. Involucres broadly campanulate to hemispheric, 4-6 mm high, 10-12 mm wide (pressed), the bracts ca. 3-seriate, subequal. Receptacle convex, paleate, the pales obtuse, blunt. Ray florets, ca. 13, pistillate or neuter, sometimes on the same plant as on the holotype, the ligules 6-8 mm long, 2-5 mm wide, yellow. Disk florets numerous, the corollas yellow, ca. 5 mm long, glabrous above or nearly so, the tube sparsely pilose, ca. 1 mm long, the lobes 5, ca. 0.5 mm long, glabrous. Anthers black, the appendages yellow. Achenes (immature) ca. 3.5 mm long, glabrous, the awns ca. 1.5 mm long.

ADDITIONAL SPECIMENS EXAMINED: MEXICO. Nuevo León: Mpio. Aramberri, San Francisco, gypsum hillside, 13 May 1992, *Hinton et al.* 21963, 21975 (TEX).

Verbesina aramberrana is clearly very closely related to *V. hintoniorum* B.L. Turner and *V. zaragozana* B.L. Turner, all of these occurring on gypsum substrates in southern Nuevo León, México (Turner 1985, 1992). Nevertheless, while possessing similar habits, the foliage of each is characterized by differences in vestiture that are quite remarkable: *Verbesina zaragozana* with densely ashy-white tomentose hairs; *V. hintoniorum* with moderately appressed-pilose soft hairs; *V. aramberrana* with sparse coarsely-hispid hairs. In addition, each is confined to rather localized habitats, none occurring together so far as known, nor do I detect intermediates suggestive that these three taxa would better be described as varieties of a single species.

ACKNOWLEDGMENTS

I am grateful to Guy Nesom for the Latin diagnosis, and to him and Luis Hernández for reviewing the manuscript.

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**A NEW SPECIES OF *MELAMPODIUM* (ASTERACEAE, HELIANTHEAE)
FROM JALISCO, MEXICO**

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ABSTRACT

A new species, *Melampodium mayfieldii* B.L. Turner, is described from near El Tuito, western Jalisco, México. It is closely related to the widespread *M. americanum* but is readily distinguished by its shrubby habit, merely pilose leaves, involucral bracts with purple-scarious margins, and large showy ray florets (ligules mostly 8-12 mm long vs. mostly 3-7 mm long).

KEY WORDS: Asteraceae, Heliantheae, *Melampodium*, México, Jalisco

Routine identification of Mexican Asteraceae has revealed the following novelty.

***Melampodium mayfieldii* B.L. Turner, sp. nov.** Figure 1. TYPE: MEXICO. Jalisco: "ca. 10 km up road which originates on the coastal highway to Puerto Vallarta at a point 2.5 mi NW of the town of El Tuito (ca. 20°23'N, 105°16'W), in forest of pines and oaks with *Podocarpus*, *Dioon*, *Styrax*, along stream, 850 m, 12 Jan 1993, *Mark H. Mayfield* 1641, with B.L. Westlund and J. Sanchez-Ken (HOLOTYPE: TEX!; Isotypes: MEXU!, NY!).

Melampodium americanum L. similis sed differt habitu (frutices expansi vs. herbae suffruticosae), foliorum paginis inferis trichomatibus brevibus (1.0-1.5 mm longis vs. 3-6 mm longis) pilosis non-floccosisque, bracteorum involucralium marginibus purpurei-scariosis (vs. herbaceis), et flosculis radii ligulis longioribus (8-12 mm longis vs. 3-7 mm).



Figure 1. Photograph of holotype of *Melampodium mayfieldii*.

Small spreading shrubs to 50 cm high and ca. as wide. Stems woody, persistent, new annual growth arising from well-defined woody shoots 10-30 cm above the ground-level, the young shoots densely pilose. Leaves simple throughout, sessile or nearly so, the blade epiiolate or passing into an indistinct petiole, connate, oblanceolate, mostly 3-4 cm long, 0.8-1.2 cm wide, densely and evenly white-pilose beneath with incurved hairs 1.0-1.5 mm long (these not at all elongate, silky and entangled as in *Melampodium americanum*), the upper surfaces similarly pubescent but less so. Heads 2-3 cm wide across the expanded rays, single, terminal, on peduncles mostly 3-7 cm long. Principal involucral bracts 5, broadly obovate, somewhat cuspidate, the apical margins clearly purple-scarious. Ray florets 8-13, the ligules bright yellow, 8-12 mm long, 3-5 mm wide. Receptacular bracts with broadly expanded, 2-3 lobed yellow-scarious apices. Disk florets numerous, sterile, the corollas yellow. Achenes ca. 3 mm long, 1.5 mm wide, laterally ornate with 3-4 warty ribs, the enclosing bract not producing a hood.

On first inspection I took the present material to be an unusually suffructicose collection of the widespread highly variable *Melampodium americanum* L. Closer inspection revealed a number of features that readily distinguish *M. mayfieldii* from the latter, including the following: 1) shrubby habit, any new growth arising from woody stems well above the ground level (vs. herbs with new annual growth from ground level); 2) relatively thick, broad, simple leaves which are uniformly pilose beneath with recurved, short hairs mostly 1.0-1.5 mm long (vs. long, silky, silvery-white hairs 3-6 mm long); 3) larger involucral bracts with well-defined purple-scarious apical margins (vs. herbaceous throughout); and 4) ligules of ray florets mostly 8-12 mm long (vs. mostly 3-7 mm long).

Neither Stuessy's (1972) revisionary treatment of *Melampodium* nor McVaugh's (1984) floristic portrayal of that genus for Jalisco will account for the present taxon. In the former, it will key to *M. linearilobum* DC. (an annual having involucral bracts with yellow-scarious margins); in the latter it will not key because of its non flocculent pubescence on the undersurfaces of leaves, but if this character were denied, it would also key with difficulty to *M. linearilobum*.

It is a pleasure to name this species for Mr. Mark H. Mayfield, terminal year doctoral student at the University of Texas, Austin, who is preparing a monographic study of the genus *Poinsettia* (Euphorbiaceae). He called my attention to the material concerned and participated in its discovery.

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A NEW SPECIES OF *BRICKELLIA* (ASTERACEAE, EUPATORIEAE) FROM NUEVO LEON, MEXICO

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ABSTRACT

A new species, *Brickellia aramberrana* B.L. Turner, is described from southernmost Nuevo León, México. It is closely related to the widespread *B. grandiflora* but differs in having glandular pubescent stems and outer involucral bracts ovate, without terminal appendages.

KEY WORDS: Asteraceae, Eupatorieae, *Brickellia*, México

Routine identification of Mexican Asteraceae has revealed the following novelty.

Brickellia aramberrana B.L. Turner, *sp. nov.* Figure 1. TYPE: MEXICO. Nuevo León: Mpio. Aramberri, N of Aramberri, pine woods, 950 m, 30 Nov 1989, Hinton *et al.* 20050 (HOLOTYPE: TEX!).

Brickelliae grandiflorae A. Gray similis sed foliis late ovatis (vs. cordatis vel sagittatis ad basim), caulis dense glandulosi-pubescentibus (vs. puberulis), et bracteis exterioribus involucri ovatis (vs. linearibus vel ovatis appendicibus linearibus) differt.

Suffruticose perennial herbs or shrublets 1.0-1.5 m high. Stems terete, densely glandular-pubescent with short hairs 0.2 mm long or less. Midstem and upper leaves of primary shoots decidedly alternate, those on secondary shoots apparently opposite, mostly 12-15 cm long, 4-7 cm wide; petioles 2-3 cm long, pubescent like the stems; blades broadly ovate to subdeltoid, not at all cordate, atomiferous-glandular beneath, the major veins with puberulous eglandular hairs, the margins crenulodentate, the apices acute. Heads numerous, arranged in both terminal and axillary cymes, the ultimate peduncles



Figure 1. Photograph of holotype of *Brickellia aramberrana*.

drooping, mostly 1-2 cm long, pubescent throughout with capitate-glandular hairs. Involucres 10-12 mm high, 10-12 mm wide (pressed), the bracts 4-5 seriate, the outer series ovate, glandular-pubescent, without linear extensions, the middle bracts linear-lanceolate, 4-7 costate, the margins scarious, the apices acute. Receptacle convex, ca. 3 mm across, pubescent. Florets 26-30 per head. Corollas yellowish, tubular, glabrous, 6-7 mm long, the lobes ca. 0.5 mm long. Achenes 4-5 mm long, moderately strigose, the pappus of ca. 30 white delicate barbellate bristles 6-7 mm long.

ADDITIONAL SPECIMEN EXAMINED: Same locality and date as for the type, *Hinton et al. 20031* (TEX!).

Brickellia aramberrana is clearly related to the widespread and highly variable *B. grandiflora* A. Gray. The latter also occurs in Nuevo León, represented at TEX by twelve or more sheets from higher elevations (1400-2400 m) between Monterrey and Aramberri. All of these possess cordate leaves, puberulent stems, strigo-pilose (eglandular) peduncles, and outer bracts of the involucres either linear or with linear extensions. *Brickellia aramberrana*, in contrast, has ovate leaves, densely glandular-pubescent stems and peduncles, and the outer bracts of the involucre are not linear, nor do they possess linear appendages. It also appears to occur at significantly lower elevations.

Over the broad range of *Brickellia grandiflora* (throughout the western U.S.A. from Washington to Missouri and southwards) considerable variation exists, but among the 150 or more sheets that I have available to me (LL, TEX), none possesses the combination of characters called to the fore in the present description.

ACKNOWLEDGMENTS

I am grateful to Guy Nesom for the Latin diagnosis, and to him and T.P. Ramamoorthy for reviewing the manuscript.

**A NEW SPECIES OF *PSATHYROTOPSIS* (ASTERACEAE, HELENIEAE)
FROM COAHUILA, MEXICO**

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ABSTRACT

A new species, *Psathyrotopsis hintoniorum* B.L. Turner, is described from near Parras, southern Coahuila, México. It is closely related to *P. purpusii* Brandegee, also from southern Coahuila. The former is readily distinguished by its larger nearly entire leaves and larger heads on longer glandular-pubescent peduncles.

KEY WORDS: Asteraceae, Helenieae, *Psathyrotes*, *Psathyrotopsis*, México

Routine identification of Mexican Asteraceae has revealed the following novelty, which is placed in the genus *Psathyrotopsis* Rydberg. Strother & Pilz (1975) included *Psathyrotopsis* within the older genus *Psathyrotes* A. Gray. Robinson (1981), however, not only recognized both genera, but he also positioned them in different subtribes (Gaillardiinae and Chaenactidinae, respectively). Except for subtribal positions, I agree with Robinson's assessment. Not only does *Psathyrotes* produce achenes with noncarbonized achene walls (compared to carbonized in *Psathyrotopsis*), but the several species described to date have truncate style branches (compared to linear-lanceolate in *Psathyrotopsis*). With description of the present, *Psathyrotopsis* has three species, all confined to northcentral México and closely adjacent areas.

***Psathyrotopsis hintoniorum* B.L. Turner, sp. nov.**, Figure 1. TYPE: MEXICO. Coahuila: Mpio. Parras, S of Parras, common on shale outcrops, 1405 m, 1 Mar 1993, *Hinton et al.* 22692 (HOLOTYPE: TEX!).



Figure 1. Photograph of holotype of *Psathyrotopsis hintoniorum*.

Psathyrotopsis purpusii Brandegee similis sed caulibus foliatis (vs. foliis fasciculatis ad basim caulis), laminis foliorum late ovatis ac integris vel fere integris (vs. subtiliter crenulatis), capitulis in pedunculis longioribus (20-30 mm longis vs. 8-20 mm), et bracteis involucri manifeste glandulosi-pubescentibus (vs. eglandulosis) differt.

Suffruticose perennial white-tomentose herbs 10-20 cm high. Stems 2-5 cm thick, densely white-tomentose. Leaves opposite, densely white-tomentose, 3-6 cm long, 1.5-2.7 cm wide; petioles mostly 1-2 cm long; blades ovate, 3-nervate, the margins entire to indistinctly undulate. Heads eradiate, 1-3 on short terminal peduncles, the ultimate peduncles glandular-pubescent, 2-3 cm long. Receptacles epaleate, involucres campanulate, 10-12 mm high, ca. 14 mm wide (pressed), the bracts ca. 23, subequal, 2-3 seriate, both densely white-tomentulose and glandular-pubescent. Florets 20-30 per head (estimated), the corollas yellow, 7-8 mm long, cylindric, glandular-pubescent, the tube ca. 1 mm long, the lobes 5, ca. 1.2 mm long. Achenes linear-oblanceolate, 3.0-3.5 mm long, densely pubescent with straight, upwardly-appressed hairs 0.5-1.0 mm long; pappus of numerous bristles 2-5 mm long, these arranged in 2-4 series.

Psathyrotopsis hintoniorum is clearly closely related to *P. purpusii* but is markedly different by the several characters noted in the Latin diagnosis. According to Strother & Pilz (1975) the latter species is known only from the type locality (ca. 100 km W of Saltillo, Coahuila, near Marte, a railroad station, where it reportedly occurs at ca. 1200 m in light sandy soils at the foot of talus). According to the most recent Carta de México (3rd impression, 1988; ISBN 968-892-214-5), Estación Marte is located at ca. 25°42' N, 101°46' W, along the lowermost southwestern flanks of Sierra La Paila; *Psathyrotopsis hintoniorum* occurs in the Sierra Parras, which is about 50 km WSW of the Sierra La Paila.

The species is named for the Hinton family present and past, who have contributed so much to our knowledge of the Mexican flora (cf. Turner 1993).

ACKNOWLEDGMENTS

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**A NEW SPECIES OF *AGERATINA* (ASTERACEAE, EUPATORIEAE) FROM
NUEVO LEON, MEXICO**

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ABSTRACT

A new species of *Ageratina*, *A. viejoana* B.L. Turner, is described from Cerro Viejo, southern Nuevo León. It appears on technical characters to belong to the subgenus *Ageratina*, having the pubescent corollas of the species of that taxon, but on total characters it seems closest to species belonging to the subgenus *Neogreenella*.

KEY WORDS: Asteraceae, Eupatorieae, *Ageratina*, México

Routine identification of Mexican Asteraceae has revealed the following novelty.

***Ageratina viejoana* B.L. Turner, sp. nov.** TYPE: MEXICO. Nuevo León: Mpio. Zaragoza, Cerro El Viejo, oak and pine woods, 2405 m, 12 Oct 1992, *Hinton et al. 22484* (HOLOTYPE: TEX!).

Speciei Mexici *Ageratinæ perezii* B.L. Turner similis sed foliis tenuioribus petiolis gracilibus multo longioribus (30-35 mm longis vs. 10-15 mm longis) et corollis purpurascensibus (vs. albis) differt.

Suffruticose herbs or subshrubs ca. 60 cm high. Stems striate, greenish, densely pubescent with glandular-puberulent hairs 0.1-0.2 mm high. Midstem leaves 10-12 cm long, 5-6 cm wide; petioles 3.0-3.5 cm long; blades deltoid to subcordate, 3-nervate from the very base, moderately soft-puberulent beneath, the margins crenulate. Heads ca. 20, arranged in terminal loose bracteate cymes, the ultimate peduncles mostly 5-20 mm long, densely glandular-puberulent. Involucres campanulate, the bracts ca. 13, subequal, 8-10 mm long, densely glandular-puberulent. Receptacle plane, glabrous. Florets 15-20 per head (estimated). Corollas ca. 6.5 mm long, pinkish-purple, the tube ca. 2 mm

long, the lobes ca. 1 mm long, decidedly pubescent with multiseptate hairs. Achenes (immature) cylindric, ca. 2.5 mm long, hispidulous; pappus of 20-30 fragile bristles ca. 5.5 mm long.

ADDITIONAL SPECIMEN EXAMINED: same locality and date as type, *Hinton et al. 22504 (TEX)*.

This species and *Ageratina perezii*, with which it is compared in the above diagnosis, belong to the subgenus *Ageratina* as defined by King & Robinson (1987), both having the fragile pappus and pubescent corollas of that subgenus. Nevertheless, both clearly resemble the widespread *A. cardiophylla* (B.L. Robins.) R.M. King & H. Robins., having the foliage and vestiture of that taxon. *Ageratina cardiophylla* belongs to the subgenus *Neogreenella*, the latter technically recognized by its tubular, glabrous corollas. It would appear that the "defining characters" of these two subgenera occasionally break down among those species of México having cordate leaves, or else cordate leaves have arisen in parallel in both.

ACKNOWLEDGMENTS

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STUDIES ON THE GENUS *BIDENS* L. (COMPOSITAE) FROM THE EASTERN HEMISPHERE. 7. A REAPPRAISAL OF *BIDENS DIVERSA* SHERFF

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ABSTRACT

The southern African species *Bidens diversa* Sherff is re-examined. It is shown to consist of two allopatric, morphologically distinct forms occurring in Angola, and Mozambique, Tanzania and Zambia respectively. They are distinguished primarily by characters of the ray and disc florets. These differences are afforded subspecific status requiring the new combination *Bidens diversa* ssp. *filiformis* (Sherff) T.G.J. Rayner (= *Bidens filiformis* Sherff). A detailed taxonomic appraisal and full synonymy and descriptions are provided for both taxa.

KEY WORDS: *Bidens*, Compositae, taxonomy, Africa

Bidens diversa Sherff is a most beautiful slender annual species possessing deeply divided leaves with narrow lobes, small but showy radiate capitula with yellow rays and apically usually orange, red or purple paleae which provide a stark contrast to the dark brown or black cypselas. It occurs in a narrow band across southern Africa, extending from Angola in the west, through Zambia to Mozambique and Tanzania in the east. Within the range of its distribution two distinct morphological forms may be recognized. These are treated here as representing subspecies. The western form (ssp. *diversa*) is restricted to Angola. Plants from this area are primarily characterized by their obtiangular-obovate, truncate and usually tridentate ray florets. By contrast, in specimens of the eastern form (ssp. *filiformis*), from Mozambique, Tanzania and Zambia, these are narrowly elliptic to narrowly elliptic-obovate and rounded and 1-3-denticulate at the apex.

Bidens diversa was described by Sherff (1923) from two specimens of *J.M. Antunes 315* (at B) collected from Mounyino in Angola. Although both sheets of the original material are apparently destroyed, Sherff's brief but detailed

description and later published illustration (Sherff 1937) easily enable the application of this name to be ascertained. As a consequence, I had no qualms about selecting *Borges 167* as the neotype (Rayner 1992). A number of other specimens also closely match Sherff's protologue. This has enabled an emended description of this species to be provided.

Sherff (1931) later published a variety *megaglossa* Sherff which he (Sherff 1937) distinguished from var. *diversa* by its "Involucri bracteae exteriore cilatae, ligulis 7-13 mm. longis." This taxon was based on a specimen collected by F.X.O.A. Newton from Bibala in the Serra da Chela, about 20 miles to the northwest of the type locality of *Bidens diversa*. Although this specimen is also destroyed, the characters provided by Sherff, and considered by him to be diagnostic, form part of the normal variation of the species as circumscribed here. Similar considerations apply to *B. diversa* var. *quilembana* Sherff (1957), described from the single specimen of *A.W. Exell & F.A. Mendonça 2524* at BM. Sherff considered that this variety differed from var. *diversa* by its "ligulis vix longioribus, bracteis exterioribus interdum etiam 3 mm. longis, aristis plerumque nudis rarius basim versus erecte 1-spinulatis." A comparison of this specimen and the duplicates at COI and LISJC with Sherff's original description of *B. diversa*, however, shows that the rays and the outer phyllaries are not or only slightly longer than those of the type of *B. diversa*, and that the implied absence of retrorse barbs on the aristae of *Exell & Mendonça 2524* is in fact incorrect. On at least two of the cypselas these are clearly evident.

Bidens cochlearis Merxm. was described by Merxmüller (1954) from specimens of the collection *H. Hess 52/1531* at M and ZT. This collection agrees with Sherff's description of *B. diversa* for most characters except that the rays are somewhat longer and tridentate at the apex, and the apices of the central paleae are mostly cochleariform. Collections of *B. diversa* exist, however, which possess both bidentate and tridentate rays of intermediate length, as well as capitula lacking cochleariform paleae. As a consequence *B. cochlearis* is not thought to represent a taxon distinct from *B. diversa*. In his protologue, Merxmüller compared *B. cochlearis* with *B. lineariloba* Oliv., stating that "Diese Art zeigt deutliche Verwandtschaft mit *B. lineariloba* Oliv., die im tropischen Ostafrika beheimatet ist und mit der sie im wesentlichen den Blattzuschnitt, die Köpfchen- und Hüllenform und die langen, schlanken Achänen, vor allem aber die stark verlängerten inneren Spreuschuppen gemeinsam hat." He considered *B. cochlearis* to be distinguishable from *B. lineariloba* in a number of ways, most dramatically by the scarlet cochleariform paleae. In fact *B. lineariloba* appears to lack any close relationship with *B. diversa*, resembling it only in habit and leaf morphology. These two taxa are readily distinguished by their cypselial aristae. In *B. diversa* these are erect or slightly divergent, slender and only up to about 2 mm long. By contrast, in *B. lineariloba* the aristae are thick, 3.4-6.2 mm long and orientated more or less perpendicularly to the axis of the cypselae.

Sherff's description of *Bidens filiformis* was based on the single specimen of *B.D. Burtt* 6269 at F, collected from Lake Chila in northeastern Zambia. This and other specimens of this taxon from Zambia, as well as a number of collections from Mozambique and Tanzania, are characterized by their annual habit, deeply divided leaves with filiform or linear lobes, narrowly elliptic to narrowly elliptic-ovate ray florets and linear to narrowly elliptic-linear cypselas. In his protologue of *B. filiformis*, Sherff (1939) rightly compared this taxon with *B. diversa* var. *megaglossa*, considering that it differed by "its proportionately narrower, more elongate outer involucral bracts, these commonly ciliate and 4-5 mm. not ciliate and only 1-2 mm. long, [and] in having a purplish tinge near the tops of the inner involucral bracts and of the outer paleae". As mentioned above, *B. diversa* var. *megaglossa* is not considered worthy of formal recognition within *B. diversa*. Although the presence of purple apices on the inner phyllaries and outer paleae is found in many specimens of ssp. *diversa*, the differences in outer phyllaries noted by Sherff form part of the suit of characters considered here to distinguish *B. diversa* ssp. *filiformis* from *B. diversa* ssp. *diversa*. In most features, including habit, and stem, leaf and fruit morphology and indumentum, plants of the eastern form are identical with those of *B. diversa* from Angola. Indeed, non-flowering specimens and fruits can not be distinguished. A number of capitular organs, however, are strikingly dimorphic between the eastern and western forms. As noted above, plants from the two areas are primarily characterized by differences in ray floret shape. Other qualitative differences include the shape of the disc floret corollas. In ssp. *diversa* these are infundibular with usually more or less convex sides, whereas in ssp. *filiformis* the corollas are cylindric and rounded at the base. Differences are also apparent in the indumentum. The paleae of ssp. *filiformis* often possess glandular hairs, whereas in ssp. *diversa* they are always glabrous. In addition, many of the differences between the two forms are the result of discrete quantitative variation. This is particularly apparent for the stamens which are larger in all their constituent parts in plants of ssp. *filiformis*. A similar variation in size is found for the styles and corolla lobes.

The decision to recognize the two forms as subspecies has been determined primarily by the heterofacial nature of *Bidens diversa* and follows the use of this category as proposed by Du Rietz (1930). The subspecies show a certain degree of morphological intergradation between themselves, especially in vegetative and fruit characters, and due to the large number of attributes in common clearly form a monophyletic group. At the same time they are distinguished by a number of morphological differences. The small number of qualitative differences precludes the possibility of maintaining the two forms as separate species. Nevertheless the dissimilarities are sufficient to enable the two forms to be effectively identified and their place of origin to be easily determined.

Bidens diversa is most closely allied to *B. acuticaulis* Sherff, a taxon with

which it shares a largely coincident distribution. The two species possess a number of features in common, including leaf morphology, phyllary and palea shape, and usually arista morphology and indumentum. They are distinguished primarily by characters of the ray florets and cypselas. In *B. acuticaulis* the former are mostly smaller and a decidedly paler yellow than in *B. diversa*. The fruit of *B. acuticaulis* are distinctly attenuate above and provided with a rostrum which may be up to about 25 cm long. By contrast, in *B. diversa* the attenuation is less abrupt, the beak absent and consequently the cypselas much shorter.

Bidens diversa Sherff, Bot. Gaz. 76:159. 1923; Sherff, Field Mus. Nat. Hist., Bot. Ser. 16:329, t. 75, f. a, b, d-i. 1937. TYPE: ANGOLA. Huilla, Lubango, Tundavala, at 12 km, source of the Inhames, 30 Apr. 1971, A. Borges 167 (NEOTYPE [selected by Rayner 1992]: LISC; Isoneotypes; M,P,PRE,SRGH).

Annual herbs, to 15-75(-110) cm tall; stems solitary, arising from a short (to 0.7-2.8 cm long) taproot with scattered, branched, adventitious roots; stems erect, sometimes more or less prostrate or ascending at base, simple or branched chiefly above; stems and branches tetragonal or subtetragonal to more or less terete, 0.9-4.3 mm diam. near base, 0.6-1.5(-1.9) mm diam. beneath peduncles, sulcate or striate-sulcate chiefly above, often smooth below, pale to dark brown especially below, often pale yellow-brown to green-brown above, rarely slightly woody only near base, glabrous or rarely sparsely to somewhat densely pilose especially beneath nodes, with to 0.5-1.3 mm long, variously orientated, weak, uniseriate, unibasal hairs; branches suberect to somewhat divergent. Leaves decussate, sometimes the uppermost 1-2 alternate, sessile or petiolate; lamina tripartite or 1-2(-3)-pinnatisect, with 3-7(-9) segments, rarely undivided, papyraceous, pale to medium green, sparsely to somewhat densely pilose, with to 0.20-0.45 mm long hairs, margin and median nerves of both faces with minute (to 0.05-0.15 mm long), antrorse, more or less adpressed, rigid hairs; divided leaves narrowly to somewhat broadly trullate to broadly ovate or broadly ovate-obtrullate in outline, 0.7-10.4(-11.7) cm long \times 0.3-8.9 cm wide; divided segments narrowly to broadly ovate or variously and often irregularly trullate or obtrullate-ovate in outline, 0.6-5.8 cm long \times 0.4-4.0(-4.5) cm wide; undivided segments opposite or subopposite, rarely more or less alternate, antrorsely inserted at 25-80° to rachis, filiform or linear to narrowly obovate-linear or narrowly elliptic-linear, acute to obtuse and usually mucronate at the not or only slightly callose-indurated apex, entire and somewhat thickened at the often revolute margin, (0.15-)0.30-4.20 cm long \times 0.2-2.6 mm wide; rachis narrowly oblong to narrowly obtriangular-oblong, 0.2-1.5 mm wide, generally broadest beneath leaf segments; petioles

to 0.3-3.6 cm long \times 0.3-1.8(-4.2) mm wide, somewhat canaliculate above, narrowly to broadly winged, with wings often dilated toward middle and more or less sheathing the stem, generally more or less dilated and flattened toward the clasping and connate bases, glabrous or sparsely to densely pilose chiefly on margin and beneath, pale green. Capitula radiate, heterogamous, erect, 0.9-5.8 cm diam. \times 4.9-9.0 mm high at anthesis, to 1.8 cm high in fruit, solitary at the stem and branch apices or more usually 2-3(-5) in lax cymes; receptacles flat to slightly convex at anthesis, sometimes becoming strongly convex in fruit; peduncles to 2.6-18.4 cm long, very slender, 0.3-0.6(-0.7) mm diam. at anthesis, to 0.8 mm diam. in fruit, often somewhat dilated immediately beneath capitula, subtetragonal to angled terete, shallow to deeply striate-sulcate, glabrous or more rarely sparsely to somewhat densely pilose, with to 0.1-0.2(-0.5) mm long, weak, uniseriate, unibasal, flexuous hairs; ebracteate or with 1-3(-4), alternate, (0.5-)2.6-22.0(-34.0) mm long, undivided or more rarely tripartite or pinnatisect bracts resembling the leaf lobes and segments. Involucre depressed-hemispheric or broadly campanulate to cupuliform, glabrous or base sparsely pilose at anthesis, more or less glabrate in fruit, base often callose-indurated and becoming pale to dark beige in fruit; outer phyllaries uniseriate, often alternating with the inner, 5-10, linear or linear-triangular, often slightly dilated at base or in apical half, acute to obtuse and rarely somewhat sharply mucronulate at the callose-indurated apex, entire at margin, 0.9-7.6 mm long \times 0.15-0.70 mm wide at anthesis, unchanged in fruit, erect to somewhat spreading chiefly in fruit, papyraceous, pale to dark green, with 1-3, rarely paired, longitudinal, red-brown nerves with lateral nerves often only present in apical portion and central nerves usually only present in basal 1/2-4/5, glabrous or margin with isolated, to 0.05-0.40 mm long, few-cellular, uniseriate hairs; inner phyllaries uniseriate, fused at base and often for up to ca. 1/3 of length, 7-12, ovate or ovate-oblong to ovate-elliptic or more or less obovate-elliptic, often slightly contracted just beneath the acute to subobtuse apex, entire or irregularly and shallow few-denticulate-serrate at margin, 2.5-5.8 mm long \times 1.0-2.7 mm wide at anthesis, to 9.7 mm long in fruit, erect, membranous, pale stramineous, sometimes becoming purple toward apex, with a scarious, (0.20-)0.25-0.40 mm wide margin usually broadest at or above the middle, with 11-28, pale to dark red-brown nerves with at least the central paired and percurrent and the laterals often interrupted, glabrous or dorsal surface minutely hispid, apex puberulous. Ray florets 6-12, neuter; ovary narrowly oblong to oblong, 0.6-1.3 mm long \times 0.25-0.55 mm wide, glabrous or erect setose at apex, laterally biaristate or exaristate, style absent; aristae 0.20-0.35 mm long, usually glabrous; corolla tube 1.5-1.9 mm long, glabrous or sparsely pubescent, with ca. 0.1 mm long, few to many-cellular, uniseriate, mostly antrorse and adpressed, occasionally flexuous, weak hairs; ray yellow or basal 1/3 yellow-orange or orange, narrowly elliptic to narrowly elliptic-obovate and more or less cuneate at base - -

obtriangular-ovate, 3.2-27.2 mm long \times 2.6-8.1 mm wide, with 6-12, darker, longitudinal, percurrent nerves, glabrous or most sparsely pubescent beneath; apex either rounded, subentire to 1-3-denticulate, with irregular, subacute to obtuse teeth with sinuses to 0.1-0.2(-0.3) mm long, or truncate, (2-)3-dentate, with teeth acute to obtuse at apex, outer teeth 1.0-2.6 mm long \times 0.9-3.3 mm wide, usually larger than the 0.6-1.7 mm long \times 0.6-1.8 mm wide central ones. Paleae often greatly overtopping disc florets and cypselas, linear or linear-triangular to most narrowly ovate-linear, at least the inner often dilated or spatulate to cochleariform and reflexed above, acute to obtuse or rounded at apex, entire or with 1-2(-3), to ca. 0.2 mm long, acute serrations at margin, 3.9-8.6 mm long \times 0.1-1.2 mm wide at anthesis, to 14.2 mm long in fruit, thin and membranous, glabrous or dorsal surface sparsely glandular-hairy, with few-cellular, short stalked, spherical headed, dark brown hairs, sometimes puberulous at apex, pale yellow or pale stramineous with the apical portion often purple, red or orange, with 2-10 longitudinal, pale to dark red-brown nerves, often darker above. Disc florets 6-33(-41); corolla yellow, glabrous or sparsely to subdensely pubescent, with to 0.2 mm long, unilinear, irregular hairs chiefly toward apex of tube; limb infundibular with usually more or less convex sides, or cylindric and rounded at base, 1.8-3.1 mm long \times 0.8-1.5 mm diam., not annularly thickened, apex 5-lobed; lobes erect or spreading, triangular, subacute at apex, 0.3-1.1 mm long \times 0.3-0.8 mm wide, papillate at apex of dorsal surface; limb gradually or abruptly attenuate below into a narrow, 0.7-1.3 mm long \times 0.3-0.4 mm diam., terete tube; anthers 1.1-2.9 mm long \times 0.4-0.7 mm diam., brown to dark brown, often somewhat exserted; endothecial tissue with polarized thickening; apical appendages ovate-triangular, acute to obtuse at apex, 0.15-0.35 mm long \times 0.1-0.3 mm wide, with a darker median nerve, margins recurved; basal appendages sagittate or rounded sagittate, not reaching or somewhat exceeding base of the filament collar; collar 0.20-0.35 mm long \times 0.10-0.15 mm wide; filament 0.4-2.2 mm long, flat or terete; style 2.2-6.4 mm long, not or slightly contracted immediately above base, with caudate, 0.5-1.2 mm long branches; stylopodium cupuliform or cylindric. Cypselas unwinged; body linear to narrowly elliptic-linear, gradually attenuate toward apex and base, 5.3-14.5 mm long \times 0.6-1.5 mm wide, dull or shiny, dark grey or black, strongly compressed; dorsal face slightly to often strongly convex, sometimes somewhat carinate; ventral face slightly concave to more or less flat, rarely slightly convex; both faces more or less faintly 6-8-striate-sulcate, glabrous or sparsely to most densely (especially in central 3/5-4/5) antrorsely setose, with setae to 0.1 mm long, pale stramineous to orange-brown and usually arising from swollen tubercles, sometimes only tubercles present; margin more or less densely antrorsely setose, with setae to 0.3 mm long and occasionally forked at base; apex densely erect setose, laterally biaristate; aristae erect to slightly divergent, rigid, trigonous, light to dark stramineous, to 0.5-2.1 mm long \times ca. 0.1 mm wide at base, nude or with 1-4(-6) retrorse barbs in apical 2/3

and sometimes with 1-3 antrorse barbs in basal 1/3, barbs to 0.1-0.3 mm long; base of cypsela with a short (0.05-0.20 mm long), slightly to markedly dorsally produced, cartilaginous rim-like carpopodium.

Bidens diversa Sherff ssp. *diversa*

Bidens diversa Sherff var. *megaglossa* Sherff, Bot. Gaz. 92:202. 1931, *e descr.*; Sherff, Field Mus. Nat. Hist., Bot. Ser. 16:330, t. 75, f. c. 1937, *e descr. et fig.* TYPE: ANGOLA. Serra da Chela, Bibala, 3 Jun. 1883, F.X.O.A. Newton s.n. (HOLOTYPE: B[2 sheets]†).

Bidens cochlearis Merxm., Mitt. Bot. Staatssamml. München 2:33. 1954. TYPE: ANGOLA. Huilla Prov., 40 km SW of Quilengues, Mt. Eyyila, 4 May 1952, H. Hess 52/1531 (HOLOTYPE: ZT; Isotypes: M, ZT[2 sheets]).

Bidens diversa Sherff var. *quilembana* Sherff, Ann. Mag. Nat. Hist., ser. 12, 10:43. 1957. TYPE: ANGOLA. Quilemba, 4 Jun. 1937, A.W. Exell & F.A. Mendonça 2524 (HOLOTYPE: BM; Isotypes: COI, LISJC).

Bidens diversa Sherff var. *typica* Sherff, Amer. J. Bot. 34:156. 1947, *nom. invalid.*

Capitula 0.9-3.1 cm diam. \times 4.9-9.0 mm high at anthesis, to 1.8 cm high in fruit; outer phyllaries 5-8, 0.9-4.8 mm long \times 0.15-0.40 mm wide at anthesis, with marginal hairs (when present) to 0.2-0.4 mm long and usually inserted at ca. 90° to axis; inner phyllaries entire at margin, 3.4-5.8 mm long at anthesis, to 9.7 mm long in fruit, with 15-28 nerves, the laterals rarely interrupted. Ray florets with 9-12 nerves; ray obtriangular-obovate, 3.2-13.5 mm long \times 2.6-8.1 mm wide; apex truncate, (2-)3-dentate, with teeth acute to obtuse at apex, outer teeth 1.0-2.6 mm long \times 0.9-3.3 mm wide, usually larger than the 0.6-1.7 mm long \times 0.6-1.8 mm wide central ones. Paleae entire or with 1-2(-3), to ca. 0.2 mm long, acute serrations at margin, 0.6-1.2 mm wide at anthesis, glabrous. Disc florets with anthers not or exserted to 0.5 mm at anthesis; corolla glabrous or sparsely to subdensely pubescent with unilinear, irregular, to 0.2 mm long hairs chiefly toward apex of tube; limb infundibular, with usually more or less convex sides, 1.8-2.6 mm long \times 0.8-1.2 mm diam., gradually attenuate below; lobes erect or spreading, 0.3-0.4 mm long \times 0.3-0.4 mm wide; anthers 1.1-1.7 mm long; apical appendages 0.15-0.20 mm long \times 0.10-0.15 mm wide; basal appendages sagittate or rounded sagittate, not or just reaching base of the filament collar; filament 0.4-1.1 mm long, terete; style 2.2-4.4 mm long, with 0.5-0.6 mm long branches.

FLOWERING. Early April to early June.

HABITAT. Wooded savanna, in clearings, often on rocky slopes with poor soil; wet places. Alt. 1150-2250 m.

SPECIMENS EXAMINED: ANGOLA. Huilla Province - s.a., *J.M. Antunes vel E. Dekindt* 1005 (LISC); Lubango, Tundavala, at 12 km, source of the Inhames [ca. 14° 55' S 13° 31' E], 30 Apr. 1971, *A. Borges* 167 (LISC, M, P, PRE, SRGH); Cola [ca. 14° 00' S 14° 30' E], 24 May 1954, *G. Boss* s.n. (M); 40 km SW of Quilengues, Mt. Eyvila [14° 19' S 13° 53' E], alt. 1150 m, 3 May 1952, *H. Hess* 52/1531 (M, ZT[3 sheets]); 20 km SE of Lubango, on road to João de Almeida [ca. 15° 03' S 13° 38' E], 19 Apr. 1968, *L.E. Kers* 3182 (S); Lubango, source of the waterfall of Tundavala [ca. 14° 56' S 13° 28' E], alt. 2250 m, 19 Apr. 1960, *E.J.S.M. Mendes* 3750 (LISC); between Lubango and Caconda, near Cacula [ca. 14° 29' S 14° 10' E], alt. 1700 m, 2 Apr. 1970, *M. Silva* 3037 (BR, K); Lubango, Serra da Senhora do Monte, alt. 1800 m, 5 Apr. 1960, *J.B. Teixeira & A.M. Andrade* 4757 (LISC). Huilla/Namibe Provinces - 20 km from Lubango towards Bibala [14° 45' S 13° 29' E], alt. 1950-2000 m, 19 Apr. 1973, *P. Bamps, S. Martins & C. Matos* 4582 (BR, LISC); Serra da Chela [15° 00' S 13° 20' E-16° 00' S 13° 40' E], alt. 1300 m, 17 May 1937, *J. Gossweiler* 10776 (COI, K, LISJC, LISU, US). Namibe Province - Quilemba [14° 46' S 13° 28' E], alt. 1900-1950 m, 4 Jun. 1937, *A.W. Exell & F.A. Mendonça* 2524 (BM, COI, LISJC).

Bidens diversa Sherff ssp. *filiformis* (Sherff) T.G.J. Rayner, *comb. et stat. nov.* BASIONYM: *Bidens filiformis* Sherff, Field Mus. Nat. Hist., Bot. Ser. 17:600. 1939; Wild, Kirkia 6:21. 1967; M.A.E. Richards & W.V. Morony, *Check List Fl. Mbala & Distr.* :181. 1969. TYPE: ZAMBIA. Lake Chila, Apr. 1936, *B.D. Burtt* 6269 (HOLOTYPE: F; Isotypes: BM, BR, K[2 sheets]).

Bidens steppia auct. non (Steetz) Sherff: M.A.E. Richards & W.V. Morony, *Check List Fl. Mbala & Distr.*: 182. 1969, *quoad M.A.E. Richards* 16260.

Capitula 2.3-5.8 cm diam. × 5.8-8.3 mm high at anthesis, to 1.6 cm high in fruit; outer phyllaries 7-10, 3.2-7.6 mm long × 0.2-0.7 mm wide at anthesis, with marginal hairs (when present) to ca. 0.05 mm long, antrorsely inserted at ca. 45° to axis; inner phyllaries entire or irregularly and shallow few-denticulate-serrate at margin, 2.5-4.4 mm long at anthesis, to 6.5 mm long in-fruit, with 11-15 nerves, the laterals often interrupted. Ray florets with 7-9 nerves; ray narrowly elliptic to narrowly elliptic-obovate, more or less cuneate at base, 13.0-27.2 mm long × 4.2-4.7 mm wide; apex rounded, subentire or 1-3-denticulate, with irregular, subacute to obtuse teeth with sinuses to 0.1-0.2(-0.3) mm long. Paleae entire at margin, 0.1-1.0 mm wide at anthesis, glabrous or dorsal surface sparsely glandular-hairy, with few-cellular, short stalked, spherical headed, dark brown hairs. Disc florets with anthers usually

strongly exserted to 1.8-2.8 mm at anthesis; corolla glabrous; limb cylindric, rounded at base, 2.6-3.1 mm long \times 1.2-1.5 mm diam., abruptly attenuate below; lobes erect, 0.8-1.1 mm long \times 0.6-0.8 mm wide at base; anthers 2.1-2.9 mm long; apical appendages 0.25-0.35 mm long \times 0.2-0.3 mm wide; basal appendages sagittate, just reaching or somewhat exceeding base of the filament collar; filament 1.6-2.2 mm long, flat; style 5.0-6.4 mm long, with 0.9-1.2 mm long branches.

FLOWERING. Late March to late May.

HABITAT. In clearings or under trees in *Brachystegia* woodland, open bush among grass, on sandy or stony soil; frequently in wet places; occasionally as a weed of fields and fire-breaks. Alt. 820-1830 m.

SPECIMENS EXAMINED: MOZAMBIQUE. Nampula Province - Nampula [15° 09' S 39° 14' E], 15 Apr. 1937, A.R. Torre 1975 (COI,LISC).

TANZANIA. s. acc. loc., comm. 1914, E.H. Clark s.n. (BM).

ZAMBIA. Luapula Province - Samfya, NW of the post-office [11° 21' S 29° 32' E], alt. 1150 m, 14 Apr. 1963, J.-J. Symoens 10238 (BR,K). Northern Province - Kapata-Sondwa [08° 46' S 31° 10' E], alt. 1000 m, 18 Apr. 1950, A.A. Bullock 2882 (BR,K); Lake Chila [08° 50' S 31° 23' E], alt. 1500-1670 m, Apr. 1936, B.D. Burtt 6269 (BM,BR,F,K[2 sheets]); Mbala district, alt. 1330 m, Apr. 1932, A.H. Gamwell 107 (BM); Mpulungu [08° 50' S 31° 06' E], alt. 820 m, 10 Apr. 1961, J.B. Phipps & L.D.E.F. Vesey-Fitzgerald 3015 (K,LISC,M); Chilongowelo, top escarpment [08° 53' S 31° 15' E], alt. 1520 m, 3 Apr. 1952, M.A.E. Richards 1348 (K); Chilongowelo, above escarpment [08° 53' S 31° 15' E], alt. 1520 m, 19 Apr. 1952, M.A.E. Richards 1492 (K); Kalambo Gorge, Saisi [ca. 09° 07' S 31° 29' E], alt. 1830 m, 24 Mar. 1955, M.A.E. Richards 5128 (BR,K,UZL); top of escarpment above Mukoma, Inono Valley [ca. 08° 41' S 31° 18' E], alt. 1520 m, 13 Apr. 1955, M.A.E. Richards 5419 (BR,K,UZL); Chilongowelo [08° 53' S 31° 15' E], alt. 1440 m, 9 May 1957, M.A.E. Richards 9622 (K,UZL); Mbala, Simanwe Farm [08° 52' S 31° 20' E], alt. 1650 m, 24 Mar. 1959, M.A.E. Richards 12265 (K); Chilongowelo Escarpment [08° 53' S 31° 15' E], alt. 1500 m, 6 Apr. 1962, M.A.E. Richards 16260 (K,M,UZL); Kalambo Falls [08° 35' S 31° 13' E], alt. 1350 m, 16 Apr. 1966, M.A.E. Richards 21493 (K); Chiyanga stream near Kalambo road [08° 45' S 31° 19' E], alt. 1520 m, 9 May 1966, M.A.E. Richards 21471 (K,MO); path to Kalala village, 4 miles from Mbala [08° 47' S 31° 21' E], alt. 1500 m, 25 Apr. 1968, M.A.E. Richards 23235 (K); Mbala, Uningi Pans [08° 57' S 31° 23' E], alt. 1500 m, 16 May 1968, M.A.E. Richards 23267 (K); Zambia Government Ranch, Saisi Valley [ca. 09° 07' S 31° 29' E], alt. 1500 m, 20 May 1968, M.A.E. Richards 23275A (EA,K); near Kalambo Falls [08° 35' S 31° 20' E], alt. 1220 m, 23 May 1967, S.A. Robertson 589 (EA,K); top of Kambole Escarpment [ca. 08° 46' S 30° 43' E], alt. 1520 m, 22 Apr. 1969, M. Sanane 631 (K,UZL).

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GEOCARPON MINIMUM (CARYOPHYLLACEAE), NEW TO LOUISIANA

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ABSTRACT

The presence of *Geocarpon minimum* is documented in Louisiana for the first time. This federally threatened species is found in two saline prairies in Winn Parish, located in north-central Louisiana. The sites are the southernmost known for this species. Associated vascular plant taxa and an ecological description of saline prairies supporting this taxon in Louisiana are provided.

KEY WORDS: Louisiana, *Geocarpon minimum*, Caryophyllaceae, floristics, saline prairie

Geocarpon minimum Mackenzie (Caryophyllaceae) is known from southwestern Missouri, and northwestern and southern Arkansas, where it is apparently restricted to sandstone glades and saline soil prairies, respectively (Pittman 1988, 1992; Tucker 1983). The taxon was listed by the U.S. Fish and Wildlife Service as threatened in July, 1987. Following discovery of a saline prairie in Winn Parish, a survey was conducted at the site in February, 1990,

in hopes of locating *Geocarpon minimum*. This search proved successful, and the species was found at an additional site in Winn Parish in 1991. The sites are the southernmost known for this taxon. Collection data are as follows:

Geocarpon minimum Mackenzie. UNITED STATES. Louisiana: Winn Parish: Graminoid-dominated, high phase saline prairie ca. 4 km NW of Tullos, Louisiana, 2.4 km W of Castor Creek, near Saline Creek, in SW/4 Section 15, T10N, R1E; Latitude 31°50'38"N, Longitude 92°21'44"W. Plants in two separate prairie openings, approximately 275 meters apart. Sitename = Saline Creek Prairie. 13 March 1990 (McInnis *et al.* 3979 LSU); Winn Parish: High phase saline prairie ca. 5.6 km NNW of Tullos, Louisiana, ca. 1.6 km W of Castor Creek, in SW/4 Section 2, T10N, R1E; Latitude 31°52'24"N, Longitude 92°20'32"W. Plants in four separate locations in prairie. Sitename = Castor Creek Saline. 6 March 1991 (McInnis 4081 NLU).

The saline prairies supporting *Geocarpon minimum* in Louisiana are found on well-drained Pleistocene terraces associated with Castor Creek. The adjacent surficial Tertiary formation is the Cockfield Formation (Groat & Roland 1984). The natural plant community is dominated by certain shallow-rooted species of grasses, sedges, and forbs. Fruticose lichens and mosses are significant components of the community. Woody plants are absent or present in limited numbers. In general, vegetative cover varies from nearly 100% herbaceous cover in graminoid dominated areas to sparsely vegetated barren-like areas (approximately 50% herbaceous cover) to practically no cover in places termed "slick spots". Slick spots are small, scattered, circular areas within prairies where depth to the sodic horizon is very shallow or the horizon is exposed, and consequentially, they are extremely inhospitable to plant growth (Smith & McInnis 1990). The slick spots vary in size from less than one-half meter to over two meters.

The plant community of the saline prairies has been determined primarily by extreme and unusual soil characteristics. The soil is classified as Brimstone Silt Loam, a fine-silty, siliceous, thermic Glossic Natraqualf. High exchangeable sodium (and probably magnesium) levels in the soils have generated extreme soil conditions for plant growth, including relatively high alkalinity, very poor movement of water and air in the soil, resistance to wetting that induces droughty conditions, and a sodic horizon in the subsoil (B horizon) that produces physical attributes similar to a dense clay hardpan that is exceedingly resistant to root penetration. The soil contains relatively high levels of certain water-soluble salts, particularly in the subsoil, that are injurious to plants and may produce alkali chlorosis and mortality. Trace elements may be deficient or present at toxic levels due to high salt content (U.S. Dept. Agriculture, in press).

Geocarpon minimum occurs in relatively level, thinly vegetated, barren-like areas near the edges of slick spots. Plants occur most often in association with bryophytes and lichens that cover unvegetated soil among the relatively widely spaced vegetation. *Geocarpon* is found mostly in small groups rather than single individuals, and is scattered between fruticose lichens (*Cladonia* spp.) and other low-growing, small-sized vegetation. Commonly occurring associates include various mosses, liverworts, lichens, and the blue-green alga *Nostoc* sp., and the vascular plants *Anemone caroliniana* Walt., *Agrostis elliotiana* Schult., *Aristida* sp., *Bigelowia nuttallii* Anderson, *Callitricha nuttallii* Torr., *Centunculus minima* L., *Coreopsis tinctoria* Nutt., *Hedeoma hispidum* Pursh, *Hedyotis australis* Lewis & Moore, *Hedyotis crassifolia* Raf., *Hedyotis rosea* Raf., *Iva angustifolia* DC., *Krigia occidentalis* Nutt., *Luzula bulbosa* (Wood) Rydb., *Nothoscordum bivalve* (L.) Britt., *Oenothera linifolia* Nutt., *Plantago elongata* Pursh, *Poa annua* L., *Scirpus koisolepis* (Steud.) Gl., *Spergularia echinosperma* Céłak, *Talinum parviflorum* Nutt., *Tillaea aquatica* L., and *Tradescantia occidentalis* (Britt.) Smyth.

Subsequent field surveys of other saline prairies in Louisiana have not yielded any additional populations of *Geocarpon minimum* (McInnis & Smith 1991).

ACKNOWLEDGMENTS

We wish to give special thanks to Bill Boyd, USDA Soil Conservation Service, for information on high sodium soils in Winn Parish. Appreciation is also given to Cavenham Forest Industries who own the saline prairies with *Geocarpon minimum* and are conserving these special natural areas. We also wish to thank Dr. William D. Reese (University of Southwestern Louisiana) and Dr. R. Dale Thomas (Northeast Louisiana University) for reviewing earlier versions of this manuscript.

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**A CUBAN ENDEMIC: *HYSTERIONICA MARGINATA* (ASTERACEAE:
ASTEREAE) RATHER THAN *ASTER GRISEBACHII***

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ABSTRACT

A species endemic to the western end of Cuba (the Pinar del Río area and Isle of Pines) has most recently been treated as *Aster grisebachii* but belongs in the genus *Hysterionica* as *H. marginata* (Grisebach) Gómez Maza (= *Haplopappus marginatus* Grisebach = *Aster grisebachii* Britton). Within *Hysterionica*, the Cuban species is closely related to *H. pinifolia*, *H. filiformis*, and *H. dianthifolia*. These species, as well as the other seven of the genus, are restricted to southeastern Brazil, Uruguay, Paraguay, and northern Argentina.

KEY WORDS: *Aster*, *Hysterionica*, Astereae, Asteraceae, Cuba

In the original description of *Haplopappus marginatus*, Grisebach (1866) noted that its white rays were anomalous in *Haplopappus*. Gómez de la Maza (1890) early recognized that *Hysterionica* was the correct generic identity of Grisebach's species, but his opinion has not been followed since then and only barely acknowledged. Britton (1914) provided no comments other than an abbreviated description of the species in his transfer of *H. marginatus* to *Aster*, but he did note the white rays and presumably was influenced in his taxonomic decision by their color. Most recently, Alain (1962) treated the species as *Aster grisebachii* and included *Hysterionica marginata* as a synonym, although he spelled the genus as "Hystrionica." The species was not included as *Aster* in recent taxonomic surveys of the genus (Jones 1980; Semple & Brouillet 1980), nor has it been mentioned in taxonomic treatments of *Hysterionica* (Cabrera 1946; Ariza E. 1980). I have found no comment past 1962 regarding its taxonomic position.

Hysterionica marginata (Grisebach) Gómez Maza, Anal. Soc. Española Hist. Nat. Madrid 19:272. 1890. [The publication citation in the Gray Card

Index is incorrect.]. BASIONYM: *Haplopappus marginatus* Grisebach, *Catalog. Pl. Cubens.* 149. 1866. *Aster grisebachii* Britton, *nom. nov.*, Bull. Torrey Bot. Club 41:14. 1914. Not *Aster marginatus* Kunth 1818.

Aster grisebachii Britton forma *angustissima* Marie-Victorin ex Alain, Contrib. Ocas. Mus. Hist. Nat. Colegio "De La Salle" 7:84. 1946.

Hysterionica comprises eleven species, which occur in southeastern Brazil, Uruguay, Paraguay, and northern Argentina, with *H. marginata* disjunct in western Cuba. The genus has been the subject of two taxonomic studies (Cabrera 1946; Ariza E. 1980), although the more recent included only a portion of the species. There appear to be two, relatively clearly recognizable species groups within the genus:

1. Plants perennial, with branching caudices; leaves filiform to linear-oblanceolate, basally disposed; heads solitary on long scapes or merely bracteate stems. the "pinifolia group"
- 1) Plants annual or perennial, with a simple caudex; leaves obovate, the basal sometimes persistent but the cauline also prominent and little reduced upwards; heads in loose clusters on leafy stems. the "jasonioides group"

The Cuban species of *Hysterionica* is a member of the "pinifolia group", which includes *H. pinifolia* (Poir.) Baker, *H. filiformis* (Spreng.) Cabrera, and *H. dianthifolia* (Griseb.) Cabrera (including *H. pulvinata* Cabrera). The following abbreviated description characterizes *H. marginata*: taprooted with thick caudex branches, leaves mostly basally disposed, linear-oblanceolate, crinkly-pilose with long-spreading cilia, heads solitary on long scapes, rays white (showing orange-resinous veins when dry), phyllaries narrowly triangular with a sharply acute apex, keeled, and with 1-3 longitudinal veins accompanied by orange resin ducts, glabrous, and achenes flat, with a double pappus. It grows in the sandy and gravelly pinelands in the Pinar del Río area and the Isle of Pines at the western end of Cuba.

Hysterionica is predominantly yellow-rayed, but there are three white-rayed species, which occur in both morphological groups: *H. marginata* and *H. dianthifolia* in the "pinifolia group" and *H. villosa* in the "jasonioides group." Whether white or yellow rays are primitive within the genus, however, there appear to have been at least two, evolutionarily independent changes of ray color. With *Conyzia* L., *Hysterionica* appears to be one of the few genera of Astereae that is unequivocally closely related to the white-rayed *Erigeron* L., where yellow rays have originated independently several times in western North America (Nesom 1992).

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**CHROMOSOME NUMBERS FOR DALEA SPECIES (FABACEAE) FROM
SOUTHWESTERN NEW MEXICO AND SOUTHEASTERN ARIZONA**

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ABSTRACT

Chromosome numbers are reported from New Mexico and Arizona for eleven taxa within the genus *Dalea*. These include counts for *D. grayi* and *D. polygonoides*, species previously counted only from Mexican material, and a new diploid count for *D. albiflora*.

KEY WORDS: Fabaceae, *Dalea*, chromosome number

The following chromosome number determinations were made from *Dalea* species growing in southwestern New Mexico and southeastern Arizona. Most of the counts are verifications of earlier counts, but a new diploid count is reported for *Dalea albiflora*, previously known only as a tetraploid. All collections were made on September 15, 16, and 17, 1989 by the three authors. The collection numbers are Sutherland's. Cytological material was stained in Snow's hydrochloric-acid-carmine stain (Snow 1963). Voucher specimens are deposited at NMC with some duplicates at OMA and NY.

Dalea albiflora A. Gray. $n=7$. UNITED STATES. Arizona: Cochise Co., 1.6 km NW of Bisbee along Old Hwy 80 (old road to Mule Pass), #6874. $n=14$. New Mexico: Sierra Co., E of the Mimbres Mts., 22.5 km N of

Nutt, 0.8 km N of Lakewood, #6851; Arizona: Cochise Co., Geronimo Trail Road, 5.5 km W of the summit, #6882. The diploid count was from a vigorous plant, with numerous stems arising from a woody, branched caudex. The two tetraploid counts reported here and the ones previously reported (Ward & Spellenberg 1988, as *D. ordiae* A. Gray) are all from slender plants that have stems arising singly and in small clusters from along a slender, creeping rootstock. This complex and variable taxon is in need of further study.

Dalea brachystachys A. Gray. $n=7$. UNITED STATES. New Mexico: Sierra Co., E of the Mimbres Mts., along NM Hwy 27, 3.4 km S of Hillsboro, #6852; E of the Mimbres Mts., along NM Hwy 152 by bridge over Percha Creek, 11.7 km W of Hillsboro, 2.2 km E of Kingston, #6859. These agree with previous counts from Texas (Turner & Fearing 1960) and from México (Mosquin 1977).

Dalea filiformis A. Gray. $n=7$. UNITED STATES. New Mexico: Grant Co., 5.5 km east of Hanover, 12.9 km east of Central, along NM Hwy 152, #6861. This is in agreement with previous counts from Arizona (Ward & Spellenberg 1988) and from México (Mosquin 1977).

Dalea grayi (Vail) L.O. Williams. $n=7$. UNITED STATES. Arizona: Cochise Co., 22.5 km off U.S. Hwy 80 along road to Herb Martyr, #6868; Arizona: Cochise Co., 1.6 km NW of Bisbee along Old Hwy 80 (old road to Mule Pass), #6875; Arizona: Cochise Co., W slope of Peloncillo Mts., Geronimo Trail Rd., 5.5 km W of the summit, #6883. These agree with a previous count from México (Mosquin 1977).

Dalea lachnostachys A. Gray. $n=7$. UNITED STATES. New Mexico: Sierra Co., E of the Mimbres Mts., along NM Hwy 27, 3.4 km S of Hillsboro, #6853; Arizona: Cochise Co., Geronimo Trail Rd., 4.3 km E of Douglas, #6876. These agree with previous counts from Texas (Turner & Fearing 1960) and from México (Mosquin 1977; Spellenberg 1979).

Dalea leporina (Aiton) Bullock. $n=7$. UNITED STATES. New Mexico: Sierra Co., E of the Mimbres Mts., along NM Hwy 27, 3 km S of Hillsboro, #6856. This agrees with previous counts for this species from eastern North America, México, and undisclosed locations (Atchison 1949, as *D. alopecuroides* Willd.; Spellenberg 1973; Mosquin 1977).

Dalea nana Torr. var. *carnescens* (Rydb.) Kearney & Peebles. $n=7$. UNITED STATES. New Mexico: Sierra Co., E of the Mimbres Mts., 22.5 km N of Nutt, 0.8 km N of Lakewood, #6850. This agrees with counts from Texas and México (Mosquin 1977).

Dalea neomezicana (A. Gray) Cory var. *neomezicana*. $n=8$. UNITED STATES.

New Mexico: Sierra Co., E of the Mimbres Mts., along NM Hwy 27, 3.4 km S of Hillsboro, #6854. This is in agreement with previous counts from Texas (Spellenberg 1977) and from México (Mosquin 1977).

Dalea pagonathera A. Gray var. *pagonathera*. $n=7$. UNITED STATES. New Mexico: Sierra Co., E of the Mimbres Mts., along NM Hwy 27, 3.4 km S of Hillsboro, #6855. This agrees with a previous report from New Mexico (Spellenberg 1973) and with counts from Texas and México (Mosquin 1977).

Dalea polygonoides A. Gray. $n=7$. UNITED STATES. New Mexico: Sierra Co., E of the Mimbres Mts., along NM Hwy 152 by bridge over Percha Creek, 11.7 km W of Hillsboro, 2.2 km E of Kingston, #6858; New Mexico: Grant Co., 5.5 km east of Hanover, 12.9 km east of Central, along NM Hwy 152, #6862. These counts agree with a report from México (Mosquin 1977).

Dalea versicolor Zucc. var. *sessilis* (A. Gray) Barneby. $n=7$. UNITED STATES. Arizona: Cochise Co., Geronimo Trail Road, 4.7 km W of the summit, #6882. This agrees with previous counts reported by Spellenberg (1973) from México and Arizona.

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**TRUE TILLANDSIAS MISPLACED IN VRIESEA (BROMELIACEAE:
TILLANDSIOIDEAE)**

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ABSTRACT

The genus *Tillandsia*, as I define it, is restricted to three species groups of *Tillandsia* subgenus *Tillandsia* sensu Gardner (1989), *Tillandsia* subgenus *Pseudalcantarea* sensu Smith & Downs (1977), and the twenty-six taxa I here remove from *Vriesea* and transfer or replace in *Tillandsia*. Ten new combinations are necessary: *Tillandsia andreettae* (Rauh) J.R. Grant, *T. boeghii* (Luther) J.R. Grant, *T. curvispica* (Rauh) J.R. Grant, *T. drewii* (L.B. Smith) J.R. Grant, *T. limonensis* (Rauh) J.R. Grant, *T. olmosana* (L.B. Smith) J.R. Grant, *T. olmosana* (L.B. Smith) J.R. Grant var. *pachamamae* (Rauh) J.R. Grant, *T. penduliscapa* (Rauh) J.R. Grant, *T. strobelii* (Rauh) J.R. Grant, and *T. tillandsioides* (L.B. Smith) J.R. Grant. In addition, four new names are proposed: *Tillandsia peruviana* J.R. Grant to replace *Vriesea sagasteguii* L.B. Smith (1968), non *Tillandsia sagasteguii* L.B. Smith (1963), *Tillandsia porphyrocraspeda* J.R. Grant to replace *Vriesea cylindrica* L.B. Smith (1951), non *Tillandsia cylindrica* S. Watson (1891), *Tillandsia werneriana* J.R. Grant to replace *Vriesea rauhii* L.B. Smith (1958), non *Tillandsia rauhii* L.B. Smith (1958), and *Tillandsia yaconorensis* J.R. Grant to replace *Vriesea koideae* Rauh (1992), non *Tillandsia koideae* Rauh & E. Gross (1991).

KEY WORDS: Bromeliaceae, Tillandsioideae, *Tillandsia*, *Vriesea*

The presence or absence of petal appendages has historically weighted heavily in delineating generic limits in the Bromeliaceae. Several genera are circumscribed and distinguished from another on this basis alone. It is in fact the primary character used to separate *Vriesea* from *Tillandsia* in Smith & Downs (1977). In preparation for a complete overview and reevaluation of generic limits in the Tillandsioideae, a number of species currently attributed to *Vriesea*

are hereby transferred to or replaced in *Tillandsia* as the circumscription of the latter is broadened in some respects while restricted in others.

It has been recognized that the circumscription of genera based on the single character of petal appendages is flawed (Gardner 1989; Brown & Terry 1992). Though there are a number of "good" genera formed entirely of species with appendages (e.g., *Portea*, *Steyerbromelia*, and *Mezobromelia*), and without appendages (e.g., *Connellia*, *Catopsis*, and *Racinaea*), there are also several quite distinct genera having species both with and without petal appendages, notably the large genera *Pitcairnia* and *Puya* (Brown & Terry 1992). Using this model, I believe there is adequate evidence for the inclusion of species with petal appendages in the traditionally non-petal-appendaged genus *Tillandsia*.

If the petal appendage character is removed in a taxonomic evaluation of the *Tillandsia*-*Vriesea* complex, a number of species attributed to *Vriesea* are morphologically more aligned to *Tillandsia* subgenus *Tillandsia*. These twenty-six taxa were placed in *Vriesea* only due to their possession of petal appendages. They in fact show no real affinities to *Vriesea*, or to the several satellite groups treated within the genus by Smith & Downs (1977). With exception to petal appendages, the twenty-six taxa here removed from *Vriesea* share all the characters for which *Tillandsia* subgenus *Tillandsia* was circumscribed in Smith & Downs (1977) and Gardner (1989). These characters especially include stamens and pistil that equal or are exserted from the corolla, petal blades that are narrow, spatulate or ligulate-shaped, and leaves which are often linear-triangular in outline and densely covered in trichomes. *Vriesea* has leaves that are only broad, ligulate shaped, and with few trichomes.

In summary, the genus *Tillandsia* is restricted taxonomically to three species groups of *Tillandsia* subg. *Tillandsia* sensu Gardner (1989), *Tillandsia* subg. *Pseudalcantarea* sensu Smith & Downs (1977), and the twenty-six petal-appendaged taxa here removed from *Vriesea*. An expanded description and circumscription of *Tillandsia* will appear in a forthcoming analysis. In regard to the five other subgenera of *Tillandsia* accepted by Smith & Downs (1977), *Pseudocatopsis* was elevated to the generic rank as *Racinaea* (Spencer & Smith 1993), while the relationships of *Allardtia*, *Anoplophytum*, *Diaphoranthema* (*Dendropogon*), and *Phytarrhiza* to one another are currently in study and will be discussed later. A complete list of species for both *Tillandsia* and *Vriesea* will be reported in an overview of those genera.

***Tillandsia andreettae* (Rauh) J.R. Grant, comb. nov.** BASIONYM: *Vriesea andreettae* Rauh, Abh. Akad. Wiss. Lit. Mainz, Math.-Naturwiss. Klasse, Trop. Subtrop. Pflanzenwelt 43:88. 1983. TYPE: ECUADOR. Azuay: Pañöhöhe, Pachamama, Straße Santa. Isabel-Pasaje, Rauh 38140 (HOLOTYPE: HEID).

Tillandsia arpocalyx André, Enum. Bromel. 7. 1888. TYPE: ECUADOR.

Chimborazo: south of Riobamba, André 4474 (HOLOTYPE: K). *Vriesea arpocalyx* (André) L.B. Smith, Contr. U.S. Natl. Herb. 29:445. 1951.

Tillandsia barclayana Baker, Jour. Bot. London 25:239. 1887. TYPE: ECUADOR. Guayas: Valdivia, *Barclay* 622 (HOLOTYPE: BM). *Vriesea barclayana* (Baker) L.B. Smith, Contr. U.S. Natl. Herb. 29:517. 1951.

Tillandsia boeghii (Luther) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea boeghii* Luther, Nord. J. Bot. 12(2):221. 1992. TYPE: ECUADOR. Loja: Parque Nacional Podocarpus, near "Centro de Información", 79° 10' W, 04° 05' S, A. *Bøgh* 86549 (HOLOTYPE: SEL; Isotypes: AAU, QCA, QCNE, LOJA).

Tillandsia castaneo-bulbosa Mez & Wercklé in Mez, Bull. Herb. Boiss. II. 3:140. 1903. TYPE: COSTA RICA. Cartago: Cartago, *Wercklé* 16189 (HOLOTYPE: B). *Vriesea castaneo-bulbosa* (Mez & Wercklé) J.R. Grant, J. Bromeliad Soc. 42(1):14. 1992.

Tillandsia cereicola Mez, Repert. Nov. Sp. 3:34. 1906. TYPE: PERU. Ancash: near Caraz, *Weberbauer* 3025 (HOLOTYPE: B). *Vriesea cereicola* (Mez) L.B. Smith, Phytologia 6:194. 1958.

Tillandsia curvispica (Rauh) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea curvispica* Rauh, Abh. Akad. Wiss. Lit. Mainz, Math.-Naturwiss. Klasse, Trop. Subtrop. Pflanzenwelt 42:53. 1983. TYPE: PERU. Amazonas: Río Marañón, *Rauh* 52835 (HOLOTYPE: HEID).

Tillandsia drewii (L.B. Smith) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea drewii* L.B. Smith, Phytologia 5:401. 1956. TYPE: ECUADOR. Imbabura: La Floresta, near Sigsipamba, *Drew* E-284 (HOLOTYPE: US).

Tillandsia harmsiana L.B. Smith, Contr. Gray Herb. 98:16. 1932. TYPE: PERU. Huánuco: Mito, *Macbride* 3272 (HOLOTYPE: F; Isotype: GH). *Vriesea harmsiana* (L.B. Smith) L.B. Smith, Contr. U.S. Natl. Herb. 29:447. 1951.

Tillandsia hitchcockiana L.B. Smith, Contr. Gray Herb. 89:10. 1930. TYPE: ECUADOR. Loja: El Tambo to La Toma, *Hitchcock* 21923 (HOLOTYPE: GH; Isotype: US). *Vriesea hitchcockiana* (L.B. Smith) L.B. Smith, Contr. U.S. Natl. Herb. 29:446. 1951.

Tillandsia incurva Grisebach, Nachr. Ges. Wiss. Gött. "1864":15. 1865. TYPE: VENEZUELA. Aragua: 6 miles southeast of Colonia Tovar, *Fendler* 1524 (HOLOTYPE: GOET; Isotype: GH). *Vriesea incurva* (Grisebach) R.W. Read, Phytologia 16:458. 1968.

Tillandsia limonensis (Rauh) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea limonensis* Rauh, Abh. Akad. Wiss. Lit. Mainz, Math.-Naturwiss. Klasse, Trop. Subtrop. Pflanzenwelt 43:85. 1983. TYPE: ECUADOR. Azuay: Bergwald bei Limon (Indanza), zwischen Paute und Mendez, Rauh 53092 (HOLOTYPE: HEID).

Tillandsia olmosana (L.B. Smith) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea olmosana* L.B. Smith, Phytologia 13:113. 1966. TYPE: PERU. Cajamarca: Valley of Olmos, Rauh P-333 (HOLOTYPE: US).

Tillandsia olmosana (L.B. Smith) J.R. Grant var. *pachamamae* (Rauh) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea olmosana* L.B. Smith var. *pachamamae* Rauh, Abh. Akad. Wiss. Lit. Mainz, Math.-Naturwiss. Klasse, Trop. Subtrop. Pflanzenwelt 43:29. 1983. TYPE: ECUADOR. Azuay: Paßhöhe Pachamama der Straße Santa. Isabel, Rauh 38139 (HOLOTYPE: HEID).

Tillandsia patula Mez, Repert. Nov. Sp. 3:35. 1906. TYPE: PERU. Junín: Huacapistana, Tarma, Weberbauer 2012 (HOLOTYPE: B). *Vriesea patula* (Mez) L.B. Smith, Phytologia 5:288. 1955.

Tillandsia penduliscapa (Rauh) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea penduliscapa* Rauh, Abh. Akad. Wiss. Lit. Mainz, Math.-Naturwiss. Klasse, Trop. Subtrop. Pflanzenwelt 18:21. 1976. TYPE: ECUADOR. Azuay: between Limon and Indanza, Rauh 37955 (HOLOTYPE: HEID; Isotype: US).

Tillandsia pereziana André, *Enum. Bromel.* 7. 13 Dec 1888. TYPE: COLOMBIA. Cundinamarca: Río Funza near Tequendama Falls, André 1348 (HOLOTYPE: K; Isotype: F). *Vriesea pereziana* (André) L.B. Smith, Contr. U.S. Natl. Herb. 29:444. 1951.

Tillandsia peruviana J.R. Grant, *nom. nov.*, Based on: *Vriesea sagasteguii* L.B. Smith, Phytologia 16:82. 1968, non *Tillandsia sagasteguii* L.B. Smith, Phytologia 8:503. 1963. TYPE: PERU. Cajamarca: Catache to Santa Cruz, Santa Cruz, López & Sagástegui 5175 (HOLOTYPE: US; Isotype: TRP).

Tillandsia petraea L.B. Smith, Contr. U.S. Natl. Herb. 29:497. 1951. TYPE: ECUADOR. El Oro: Llanos Payama, Chepel, northeast of Zaruma, Espinosa E-2002 (HOLOTYPE: US). *Vriesea petraea* (L.B. Smith) L.B. Smith, Phytologia 20:168. 1970.

Tillandsia porphyrocraspeda J.R. Grant, *nom. nov.*, Based on: *Vriesea cylindrica* L.B. Smith, Contr. U.S. Natl. Herb. 29:445. 1951, non *Tillandsia cylindrica* S. Watson, Proc. Amer. Acad. Arts 26:155. 1891. TYPE:

ECUADOR. Esmeraldas, Santo Domingo, Foster 2649 (HOLOTYPE: US).

The epithet derives from the Greek, *porphyro-*, purple, and *craspeda*, margin, to reflect the distinct purple margins on the chartreuse petals.

Tillandsia robusta Grisebach, Nachr. Ges. Wiss. Gött. "1864":15. 1865.

TYPE: VENEZUELA. Aragua: near Biscaina, *Fendler* 1525 (HOLOTYPE: GOET). *Vriesea robusta* (Grisebach) L.B. Smith, Phytologia 7:4. 1959.

Tillandsia strobelii (Rauh) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea strobelii* Rauh, Abh. Akad. Wiss. Lit. Mainz, Math.-Naturwiss. Klasse, Trop. Subtrop. Pflanzenwelt 18:17. 1976. TYPE: ECUADOR. Azuay: Río Paute near Cuenca, Rauh 37936 (HOLOTYPE: HEID).

Tillandsia tequendamae André, *Enum. Bromel.* 8. 13 Dec 1888. TYPE: COLOMBIA. Cundinamarca: Falls of Tequendama, André 1355 (HOLOTYPE: K). *Vriesea tequendamae* (André) L.B. Smith, Contr. U.S. Natl. Herb. 29:444. 1951.

Tillandsia tillandsioides (L.B. Smith) J.R. Grant, *comb. nov.* BASIONYM: *Vriesea tillandsioides* L.B. Smith, Phytologia 9:256. 1963. TYPE: PERU. Piura: near Huancabamba, Rauh P-304 (HOLOTYPE: US).

Tillandsia werneriana J.R. Grant, *nom. nov.*, Based on: *Vriesea rauhii* L.B. Smith, Phytologia 6:194. 1958, non *Tillandsia rauhii* L.B. Smith, *Bromel. Soc. Bull.* 8:44. 1958. TYPE: PERU. Cajamarca: woods near Jaen, Rauh P-390 (HOLOTYPE: US).

This new name, like both *Vriesea rauhii* and *Tillandsia rauhii*, honors Prof. Dr. Werner Rauh, Institut für Systematische Botanik und Pflanzengeographie, Ruprecht-Karls-Universität, Heidelberg, Germany.

Tillandsia yaconorensis J.R. Grant, *nom. nov.*, Based on: *Vriesea koideae* Rauh, *J. Bromeliad Soc.* 42(4):148. 1992, non *Tillandsia koideae* Rauh & E. Gross, *Abh. Akad. Wiss. Lit. Mainz, Math.-Naturwiss. Klasse, Trop. Subtrop. Pflanzenwelt* 79:19. 1991. TYPE: PERU. Cajamarca: on rocks at Lago Seco, near the river Chonta, 6 km south of Yaconora, Koide 8802142 (HOLOTYPE: HEID).

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**A NEW SPECIES OF *PERITYLE* (ASTERACEAE, HELENIEAE) FROM
SOUTHERN ZACATECAS, MEXICO**

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ABSTRACT

A new species, *Perityle glaucescens* B.L. Turner, is described from southern Zacatecas, México. The taxon has discoid heads and pinnately parted leaves; it is closely related to *P. feddeiae*, which shares these characters, but differs in having densely tomentulose glaucescent foliage (vs. glabrous and green).

KEY WORDS: Asteraceae, Helenieae, *Perityle*, México, Zacatecas

Perityle is a genus of the tribe Helenieae renowned for its very localized cliff-dwelling endemics (Powell 1973, 1974). The present novelty follows the pattern found in the sect. *Laphamia*, to which it belongs, where in close proximity are found closely related species that are strikingly different in morphology. Thus, *P. glaucescens* B.L. Turner is clearly closely related to *P. feddeiae* McVaugh, both sharing the rather unusual features of discoid heads and pinnately parted leaves, yet differs markedly in having densely tomentulose foliage and linear leaf divisions (vs. glabrous or atomiferous-glandular and divisions spatulate).

Perityle glaucescens* B.L. Turner, *sp. nov. TYPE: MEXICO. Zacatecas: km 8 along the road between El Teul and Florencia, "Rupicola, en acartilado de exposición oeste", 2000 m, 17 Oct 1992, José A. Lomeli Sención s.n. (HOLOTYPE: TEX!).

Perityle feddeiae McVaugh similis sed foliis dense penitus tomentellis, planta glaucescens (vs. glabris atomati-glandulosis, planta viridis), et foliorum segmentis ultimis plerumque spathulatis (vs. linearibus) differt.

Perennial glaucescent herbs, to 20 cm high, the delicate shoots arising from an enlarged woody root ca. 3 cm across. Stems slender, 0.5-2.0 mm thick, densely white-tomentulose. Leaves opposite throughout, those at mid-stem mostly tripartitely dissected, the ultimate segments linear to linear-oblanceolate, 4-12 mm long, 0.5-1.5 mm wide, pubescent like the stems. Heads borne singly, terminal or axillary, the ultimate peduncles mostly 1-2 cm long. Involucres campanulate, 3-4 mm high, ca. 5 mm across (pressed), the bracts ca. 11, uniserrate, linear-oblanceolate, tomentulose. Ray florets absent. Disk florets 15-30 per head (estimated), the corollas yellow, ca. 2.5 mm long, the tube ca. 1 mm long. Achenes ca. 2 mm long, the margins weakly enlarged and ciliate with short hispidulous hairs, the pappus of 2 slender awns ca. 1 mm long, between these a short erose crown of scales ca. 0.1 mm high or less.

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**NEW COMBINATIONS IN *CHAMAESYCE* A. GRAY (EUPHORBIACEAE)
FROM TEXAS AND THE CHIHUAHUAHAN DESERT**

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ABSTRACT

Chamaesyce A. Gray is a well-understood and widely-utilized generic name for a distinctive group of species that are often and justifiably segregated from *Euphorbia* L. However, a complete set of names in *Chamaesyce* is not available. New combinations, clarifications, and an updated list (Table 1) of *Chamaesyce* species are provided for Texas and the Chihuahuan Desert region.

KEY WORDS: *Chamaesyce*, Euphorbieae, Euphorbiaceae, nomenclature

The unique characteristics of *Chamaesyce* A. Gray are clear and were recently enumerated by Mayfield (1991), but the issue of generic recognition for *Chamaesyce* was not discussed. McVaugh (1993) has reviewed the various arguments for and against generic recognition of *Chamaesyce* and these need not be reiterated here. In general, however, the recognition of *Chamaesyce* as a genus distinct from the rest of *Euphorbia* L. is only a small part of separating *Euphorbia* sensu lato (=subtribe Euphorbiinae Hurasawa) into smaller generic components. An inclusive *Euphorbia* should include all of the subtribe Euphorbiinae which includes the well-known *Pedilanthus* Neck. ex Poit., *Synadenium* Boiss., *Monadenium* Pax, *Elaeophorbia* Stapf, among others, genera which have a long history but are no more separate from the core of *Euphorbia* than are such commonly included groups as *Poinsettia* Graham, *Agaloma* Raf., *Tithymalus* Gaertn., and *Chamaesyce*. Conversely, taxonomic consistency dictates the eventual recognition of the latter groups given the recognition of the former widely accepted genera. The new combinations made here do not constitute complete taxonomic consistency in either way (inclusive or segregated *Euphorbia*), but it is clear that the species of *Chamaesyce* constitute a group far removed from the group of African species which includes the type of the

genus *Euphorbia*. Such consistency may only be facilitated in a modern worldwide conspectus of the genera of cyathiate Euphorbiaceae (Tribe Euphorbieae Dumortier).

Chamaesyce chaetocalyx (Boiss.) Wooton & Standl. var. *triligulata* (L.C. Wheeler) Mayfield, *comb. nov.* BASIONYM: *Euphorbia fendleri* Torr. & Gray var. *triligulata* L.C. Wheeler, Bull. Torrey Bot. Club 63:445. 1936.

Chamaesyce fendleri (Torr. & Gray) Small var. *triligulata* (L.C. Wheeler) Shinners, Field and Lab 17:70. 1949. *Euphorbia chaetocalyx* (Boiss.) Tidestr. var. *triligulata* (L.C. Wheeler) M.C. Johnst., Wrightia 5:139. 1975.

Chamaesyce crepitata (L.C. Wheeler) Mayfield, *comb. nov.* BASIONYM: *Euphorbia crepitata* L.C. Wheeler, Contr. Gray Herb. 27:60. 1939.

Chamaesyce crepitata (L.C. Wheeler) Mayfield var. *longa* (M.C. Johnst.) Mayfield, *comb. nov.* BASIONYM: *Euphorbia crepitata* L.C. Wheeler var. *longa* M.C. Johnst., Wrightia 5:139. 1975.

Chamaesyce fruticulosa (Boiss.) Millsp. BASIONYM: *Euphorbia fruticulosa* Boiss. in DC., *Prodr.* 15(2):38. 1862. *Chamaesyce fruticosa* (Boiss.) Millsp., Field Mus. Bot. Ser. 2:409. 1916.

The epithet in Millspaugh's (1916) new combination, as well as in his citation of the basionym, was apparently misspelled in his publication; and no other species of *Euphorbia* or *Chamaesyce* has ever been published with "fruticosa" as the epithet. The combination is still attributed to Millspaugh but the corrected spelling is provided.

Chamaesyce fruticulosa (Boiss.) Millsp. var. *hirtella* (M. C. Johnst.) Mayfield, *comb. nov.* BASIONYM: *Euphorbia fruticulosa* Boiss. var. *hirtella* M.C. Johnst., Wrightia 5:141. 1975.

Chamaesyce geyeri (Engelm.) Small var. *wheeleriana* (Warnock & M.C. Johnst.) Mayfield, *comb. nov.* BASIONYM: *Euphorbia geyeri* Engelm. var. *wheeleriana* Warnock & M.C. Johnst., Southw. Naturalist 14:127-128. 1969.

Chamaesyce johnstonii (Mayfield) Mayfield, *comb. nov.* BASIONYM: *Euphorbia johnstonii* Mayfield, Sida 14:573-579. 1991.

Chamaesyce simulans (L.C. Wheeler) Mayfield, *comb. nov.* BASIONYM: *Euphorbia polycarpa* Benth. var. *simulans* L.C. Wheeler, Rhodora 43:192. 1941. *Euphorbia simulans* (L.C. Wheeler) Warnock & M.C. Johnst., Southw. Naturalist 5:170. 1960.

Chamaesyce theriaca (L.C. Wheeler) Shinners var. **spurca** (M.C. Johnst.) Mayfield, *comb. nov.* BASIONYM: *Euphorbia theriaca* L.C. Wheeler var. *spurca* M.C. Johnst., *Wrightia* 5:138. 1975.

Notes on selected species

Chamaesyce johnstonii is not included in Table I because it does not occur in Texas or the Chihuahuan Desert Region (CDR).

Chamaesyce velleriflora has been reported as new to Texas by Carr & Mayfield (in press). The nomenclature of this species has been recently questioned by McVaugh (pers. comm.) but the concept used here is the same as that (as *Euphorbia velleriflora*) in Johnston (1975).

Chamaesyce lasiocarpa (Klotzsch) Arthur (as *Euphorbia lasiocarpa* Klotzsch in Johnston, 1975) is a plant of tropical forests and does not occur in Texas or the Chihuahuan Desert region. Plants included under that name in Johnston (1975) are, in the broad sense, referable to *C. berteriana* (Balb.) Millsp. This species is relatively rare in the eastern part of the Mexican CDR. *Chamaesyce berteriana* is distinct from other *Chamaesyce* species of Texas and the CDR in having the carpillary septa of mature capsules cleft to the columella.

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Johnston, M.C. 1990. *The Vascular Plants of Texas: A List, Updating the Manual of the Vascular Plants of Texas* (2nd ed.). Published by the author. Austin, Texas. 107 pp.

Table I. List of currently accepted names for *Chamaesyce* species from Texas and adjacent Chihuahuan Desert region of México* (compiled from Johnston [1990] and Johnston [1975]).

C. acuta (Engelm.) Millsp.
C. albomarginata (Torrey & Gray) Small
C. ammannioides (H.B.K.) Small
C. angusta (Engelm.) Small
C. arizonica (Engelm. in Torr.) Arthur
C. astyla (Boiss.) Millsp.
°*C. berteriana* (Balb.) Millsp.
C. capitellata (Engelm.) Millsp.
C. carunculata (Waterfall) Shinners
C. chaetocalyx (Boiss.) Woot. & Standl.
C. chaetocalyx (Boiss.) Woot. & Standl. var. *triligulata* (L.C. Wheeler)
Mayfield
C. cinerascens (Engelm. in Torr.) Small
C. cordifolia (Ell.) Small
°*C. crepitata* (L.C. Wheeler) Mayfield
°*C. crepitata* (L.C. Wheeler) Mayfield var. *longa* (M.C. Johnston) Mayfield
°*C. cumbrae* (Boiss.) Millsp.
C. fendleri (Torrey & Gray) Small
°*C. fruticulosa* (Boiss.) Millsp.
°*C. fruticulosa* (Boiss.) Millsp. var. *hirtella* (M.C. Johnston) Mayfield
C. geyeri (Engelm.) Small
C. geyeri (Engelm.) Small var. *wheeleriana* (Warnock & M.C. Johnston)
Mayfield
C. glyptosperma (Engelm.) Small
C. golondrina (L.C. Wheeler) Shinners
C. hirta (L.) Millsp.
C. humistrata (Engelm.) Small
C. hypericifolia (L.) Millsp.
C. hyssopifolia (L.) Small
C. indivisa (Engelm.) Millsp.
C. jejuna (Warnock & M.C. Johnston) Shinners
C. laredana (Millsp.) Small
C. lata (Engelm. in Torr.) Small

Table I (cont.).

C. maculata (L.) Small
C. micromera (Boiss.) Woot. & Standl.
C. missurica (Raf.) Shinners
C. nutans (Lag.) Small
C. parryi (Engelm.) Rydb.
C. perennans Shinners
C. prostrata (Ait.) Small
C. revoluta (Engelm.) Small
°*C. scopulorum* (Brandeg.) Millsp.
°*C. scopulorum* (Brandeg.) Millsp. var. *inornata* (M.C. Johnston) Raju & Rao
°*C. scopulorum* (Brandeg.) Millsp. var. *nuda* (M.C. Johnston) Raju & Rao
C. serpens (H.B.K.) Small
C. serpyllifolia (Pers.) Small
C. serrula (Engelm.) Woot. & Standl.
C. setiloba (Engelm. ex Torrey) Millsp.
C. simulans (L.C. Wheeler) Mayfield
C. stictospora (Engelm.) Small
°*C. stictospora* (Engelm.) Small var. *sublaevis* (M.C. Johnston) Raju & Rao
C. theriaca (L.C. Wheeler) Shinners
°*C. theriaca* (L.C. Wheeler) Shinners var. *spurca* (M.C. Johnston) Mayfield
C. velleriflora (Kl. & Gke.) Millsp. BASIONYM: *Anisophyllum velleriflorum* Kl. & Gke.
C. villifera (Scheele) Small

*Basionyms of recombined names are in *Euphorbia* except as indicated in the table.

°Species of Mexican Chihuahuan Desert Region and not known to occur in Texas.

Mayfield, M.H. 1991. *Euphorbia johnstonii* (Euphorbiaceae) A new species from Tamaulipas, Mexico, with notes on *Euphorbia* subsection *Acutae*. *Sida* 14:573-579.

McVaugh, R. 1993. Euphorbiae Novo-Galicanae Revisae. *Contr. Univ. Michigan Herb.* 19:207-239.

Millspaugh, C.F. 1916. Contributions to North American Euphorbiaceae-VI. *Field Mus. Nat. Hist., Bot. Ser.* 2:401-417.

BOOKS RECEIVED

Xeriscape Gardening: Water Conservation for the American Landscape. Connie Ellefson, Thomas Stephens, & Doug Welsh. MacMillan Publishing Company, 866 Third Avenue, New York, New York 10022. xii. 323 pp. \$30.00 (hardcover). ISBN 0-02-614125-6.

The book begins with an introduction of xeriscape principles and this is followed by examples and discussions of plants for xeriscape plantings in various parts of the United States. The former includes design, soil improvement, plant selection, irrigation, mulching, and other general information. The latter lists eleven major regions in the country, and recommends plants for use in each. Appendices list suitable xeriscape plants by growth form or microhabitat situations.

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